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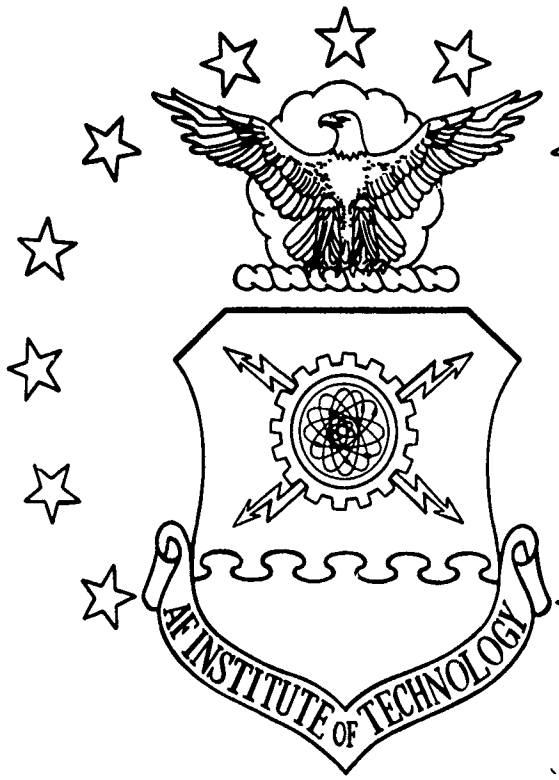

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IDENTIFICATION OF ESSENTIAL SUCCESS FACTORS FOR AN ELECTRONIC MASTER PUBLICATION LIBRARY

THESIS

Michele M. Ohotnicky, Captain, USAF

AFIT/GIR/LSM/90D-9

The opinions and conclusions in this paper are those of the author and are not intended to represent the official position of the DOD, USAF, or any other government agency.

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IDENTIFICATION OF ESSENTIAL SUCCESS FACTORS FOR AN ELECTRONIC MASTER PUBLICATION LIBRARY

THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
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Master of Science in Information Resource Management

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Captain, USAF

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Michele M. Ohotnicky

Table of Contents

List of Figures

List of Tables

Abstract

The purpose of this research was to reduce the risk associated with the development and implementation of new technologies through a better understanding of the experiences of current "electronic libraries" program managers. The Air Force has proposed using CD-ROM based technology to create an electronic master publications library. Structured interviews with ten managers experienced in the development and implementation of similar projects were conducted. The interviewees identified the following as essential success factors in developing and implementing their projects: planning; identification of user needs; clear and specific goals/objectives; system performance; developer competence; management support; and hardware interface standards. Recommendations based on lessons learned include: avoiding multidisc drives due to problems experienced; updating CD-ROM discs annually with interim changes distributed via magnetic media using software to link with CD-ROM, using the expertise and equipment of contractors in CD-ROM production, and the importance of issues related to computer searching. Finally, it is recommended that further investigation of related studies and issues continue to validate and establish the reliability and generalizability of the essential success factors identified by this study.

Keywords: Disk recording systems, Read-only memories, Theses, Systems management (ADC)

IDENTIFICATION OF ESSENTIAL SUCCESS FACTORS FOR AN ELECTRONIC MASTER PUBLICATION LIBRARY

I. Introduction

Background

On January 26 1990, the Air Force Communications-Computer Requirements Board Working Group approved the Statement of Operational Need (SON #011-89) for the Information Management Network (IM Net). Appendix A contains a copy of Secretary of the Air Force Director of Information Management (SAF/AAI) SON #011-89 and its respective attachments. IM Net is a program which attempts to modernize how the Air Force disseminates policy and provides Air Force forms through the use of electronic media which would be accessible to users with office automation equipment. Classified publications, test materials, some forms, and visual aids are excluded.

The SAF/AAI SON #011-89 for IM Net outlines the mission areas where an operational need exists, the mission element requiring support, basis of need, assessment of capability, needed capability, and proposed program. In this document, the Director of Information Management acknowledges two major shortfalls in its current ability to meet its Air Force Mission:

1. Mission readiness has been and continues to be impacted by Information Management's lack of capability to develop and implement policy to manage Air Force information, regardless of media, throughout its life cycle.

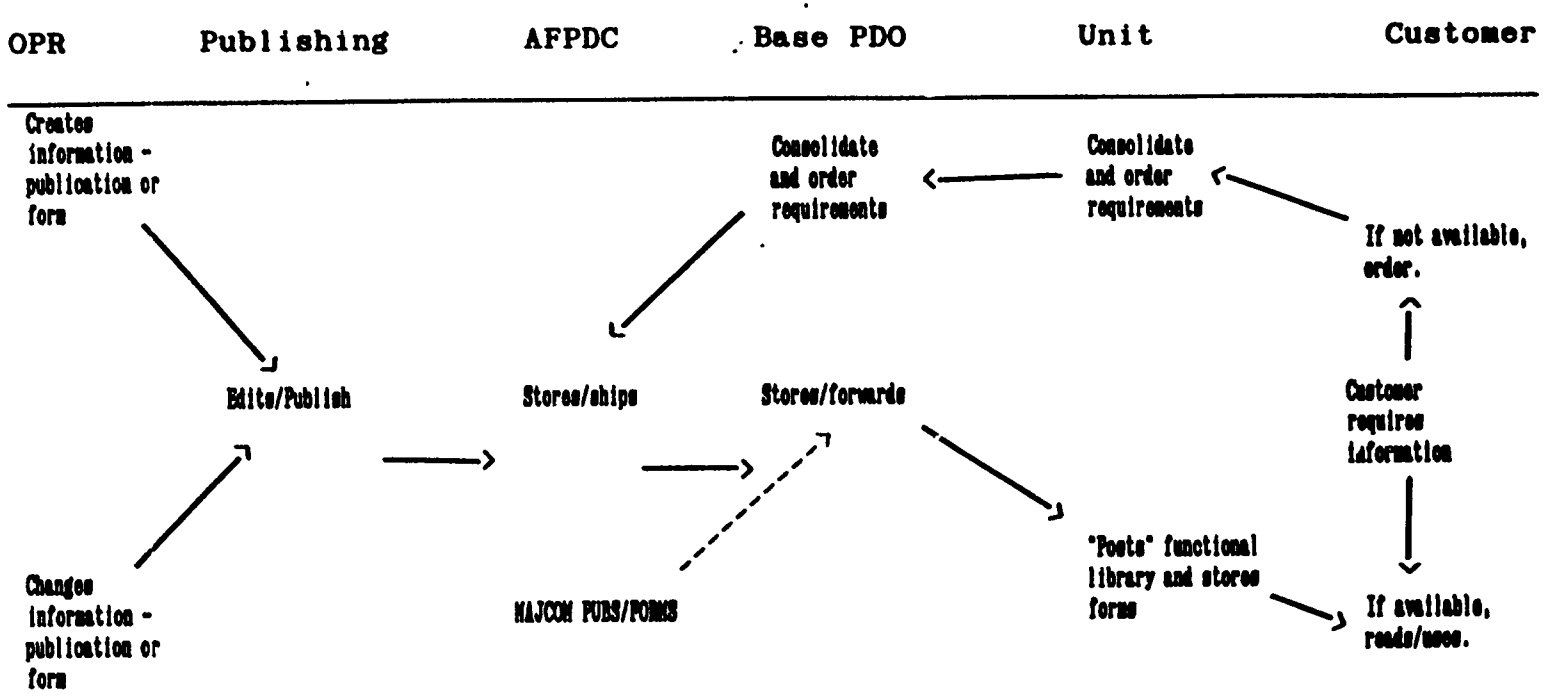
2. Mission readiness has been and continues to be impacted by the inherent incapability of the current, mostly paper-based system to disseminate Air Force policy and provide Air Force forms, regardless of media, in an accurate and timely manner. (Pardini, 1990:1)

The SON continues by describing how these mission readiness shortfalls impact Air Force commanders. First, the distribution policy which provides for dissemination of Air Force policy and procedures via Air Force publications is labor intensive. The current system, Figure 1, relies on paper copies of regulations, printed at centralized locations, held in warehouses, shipped around the world, stored in "functional libraries" or "personal libraries" and updated via manual page changes. The effectiveness of this system depends upon the efforts of the local clerk, secretary, or action officer to keep the regulations posted with "page changes."

> Unfortunately, commanders, seeking accurate information, often find they do not have current and up-to-date copies of regulations. Even worse, commanders who need access to a regulation, not previously maintained, often find that it is "backordered." (Pardini, 1990:2)

Finally, Air Force personnel using word processors, office automation systems, and similar tools to complete Air Force forms find they spend hours trying to line up preprinted forms so that information will print in the correct location (Pardini, 1990:2).

Lieutenant Colonel Norman F. Daviess, Chief of Systems Architecture and Design for the Director of Information



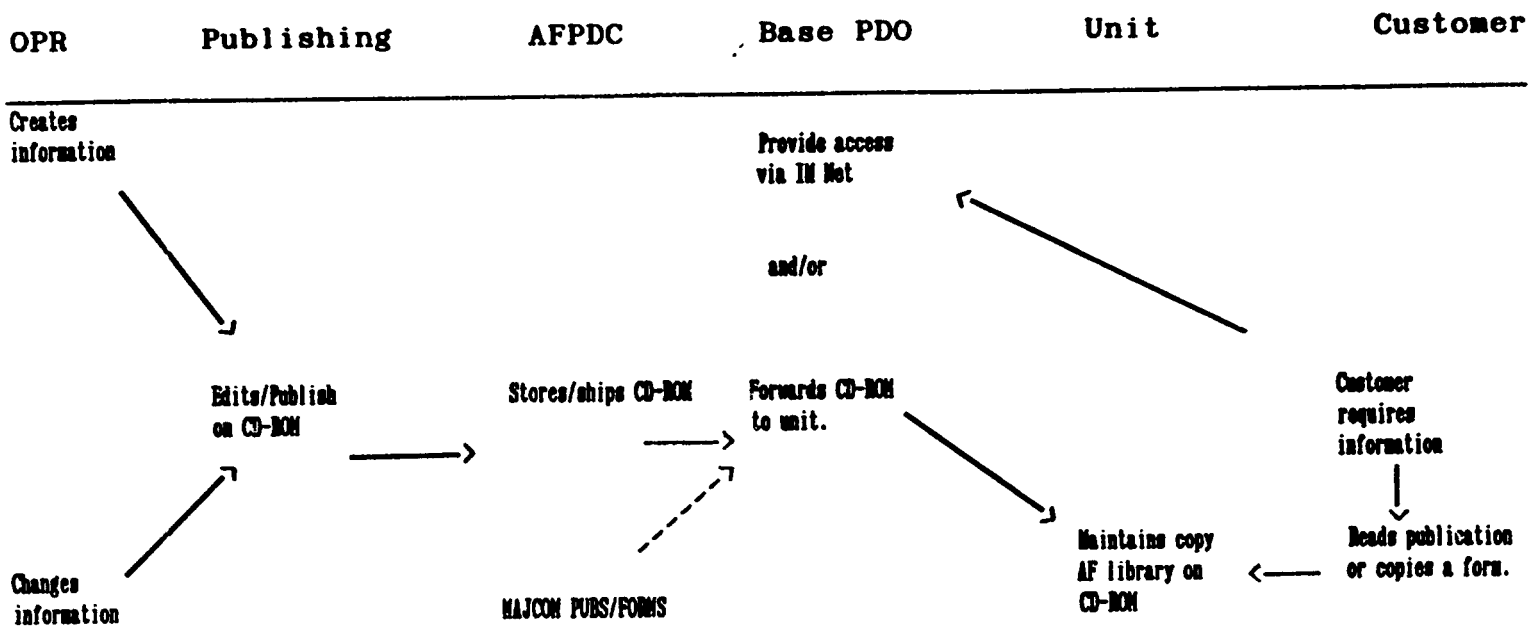
(Source: Daviess)

Figure 1. Current Information Flow

Management (SAF/AAIA) was the primary developer of SAF/AAI SON #011-89, in which he identified the general operational requirement for "electronic libraries." The proposal provides a number of options to the local commander in the form of various hardware (Air Force standard) configurations which can take advantage of a compact disk, read-only-memory (CD-ROM) library of Air Force publications and forms. As part of the current paper publishing process, the Government Printing Office has contracted for electronic publishing of the information (GPO 50-S) which creates a digitized database of the information. The CD-ROMs will be produced from this digital database (Pardini, 1990:4). Figure 2 shows the future information flow with IM Net provided in SAF/AAI SON #011-89.

General Issue

The proposed IM Net architectures place emphasis on the potential for CD-ROM technology to provide the "near-line" access of massive amounts of information (Pardini, 1990:A1-1). Near-line refers to the speed of retrieval being close to or near on-line access speed. However, the limitations of the new technology are unclear. According to Richard S. Halsey, Dean of the School of Information Science and Policy, State University of New York at Albany, it is difficult to acquire adequate knowledge just from reading about CD-ROMs because the technical, library, and promotional literatures vary in reliability, clarity, authoritativeness, and currency. Halsey recommends supple-



(Source: Daviess)

Figure 2. Future Information Flow

menting reading with personal observations, which means attending (with checklists in hand) trade shows and expositions as well as professional conferences (Halsey, 1989:57). Similarly, it may be possible for Air Force managers to learn from those with direct experience in developing and implementing CD-ROM technology.

Problem Statement

The objective of this research is to help identify success factors for developing and implementing electronic libraries. For the purposes of this research, electronic libraries are defined as databases of information accessible via an electronic medium, such as a computer, with characteristics such as key word searching, ability to be updated, ability to be distributed as necessary, and ability to serve a variety of users. The purpose of this research is to assess the success of previous and on-going electronic library projects and to make use of the knowledge their managers have gained through the development and implementation process to ensure similar projects planned for the Air Force are successful.

Research Questions

There are two basic research questions to be answered by the study:

1. What factors are essential to the successful development and implementation of electronic libraries?

2. Based on the experience of current electronic library users with CD-ROM technology, what steps can the Air Force take in project IM Net that would be beneficial?

Justification

The proliferation of computers has resulted in what is becoming known as "the information age." Despite the activities of Congress through The Paperwork Reduction Act of 1980 and The Goldwater-Nichols Department of Defense Reorganization Act of 1986, Air Force Information Management has been unable to effectively manage the vast amounts of policy and procedure information being produced, distributed, and stored.

In SAF/AAI SON #011-89, the recommendation has been made to invest in a project that will convert much of this information to a digital form and allow computers to perform search and retrieval operations. The search and retrieval of primarily textual information at the speed of the computer as opposed to the speed of a person appears to offer a more effective use of both resources. Until recently, mainframe computers were the only solution for those needing to access large volumes of information, but this solution was cost prohibitive for the Air Force. The evolution of optical technology during the 1980's has expanded this capability to the microcomputer environment and for the price, CD-ROM offers "unprecedented access." The price of CD-ROM drives today ranges from $600 to $1200, mastering services range from $1500

to $6000, and replication costs from $1.50 to $2 per disk (Eaton, et al., 1989: 11). These prices are approaching those of other peripheral devices for microcomputers and enable those heavily invested in microcomputers to imitate mainframe database access. This increase in capability is what some have termed, "bringing the power of the mainframe to the microcomputer" (FOSE CD-ROM Conference, March 1990).

However, while CD-ROM processing may be more cost-effective in the long run, the "electronic libraries" project proposed by the Air Force Director of Information Management requires an investment of over $40 million. The implementation of new technology is in itself risky, but is currently made even riskier by a tightly constrained budgetary situation. Should such a project receive funding, it is apparent that correcting an unsuccessful implementation would require resources which may simply not be available. Therefore, the identification of essential success factors in the early stages (such as prior to the statement of work) might enable us to reduce the risk by increasing our ability to recognize the most promising courses of action.

Scope

The research is exploratory and seeks to identify what factors are viewed to be essential for the success of developing and implementing electronic library technology by interviewing ten organizations (both within and outside the Department of Defense) which have undertaken electronic library

projects. Rather than focusing on specific technological aspects of CD-ROM, the research will cover the topic from the manager's perspective.

Summary

Senior Air Force information managers have identified a problem with providing commanders accurate and timely policy and procedure information. They have proposed a solution in the form of electronic libraries. This solution is heavily based on new "CD-ROM" technology. The research attempts to eliminate some of the uncertainty associated with implementing "new" technology by exploring the "lessons learned" of experienced organizations. The research involves assessing the experiences of organizations which are currently using "electronic libraries" as defined in this chapter. The next chapter provides a review of the literature which served as the basis for this research.

II. Literature Review

Overview

This chapter reviews the literature which served as a basis for the research. The literature discussed is categorized as pertaining to Air Force Publication Libraries, Air Force Publication Management, electronic publishing and libraries, information systems change, information system application development and implementation, and compact disk, read-only-memory (CD-ROM) application development and implementation.

Air Force Publication Libraries

What are publication libraries? According to Department of the Air Force Regulation 4-61, Publication Libraries and Sets, there are two basic types of publication libraries: the functional publication library and the master publication library. The master publication library is "a centralized repository of standard publications" which are defined as "regulations, manuals, supplements, operating instructions, pamphlets, bulletins, staff digests, and visual aids" (Department of the Air Force, AFR 4-61, 1989:1). The functional publication library is "a unit or staff office library that contains only publications needed for the mission in a specific functional area" (Department of the Air Force, AFR 4-61, 1989:1). Functional libraries may be further broken down into publication sets which consist of "one or more publications directly

related to one or several persons' duties" (Department of the Air Force, AFR 4-61, 1989:1).

Briefly stated, publication libraries contain the Air Force's operational guidelines, often referred to as "policies and procedures." These publications include both internal governing directives and implementation of public law. The master publication library is like a set of encyclopedias in many ways: large volumes of primarily textual information, the use of cross-referencing, and the need for review and updating in response to environmental, societal, and technological changes. Both attempt to store what is currently known and to facilitate the evolution of that knowledge.

Unlike encyclopedias, publication revisions are not made by a research committee, but by an Office of Primary Responsibility (OPR). The OPR is defined as "any headquarters, agency, or activity having primary functional interest in, and responsibility for a special action, project, plan, program, or problem" (Department of the Air Force, AFR 4-61, 1989:1).

The management of the master publication libraries are a function of the Information Management activity, Publications and Forms Management, as defined in AFR 4-1, Functions and Responsibilities of Information Management (IM) Activities, Attachment 1, item 3 (Department of the Air Force, AFR 4-1, 1989:7). As noted in Chapter 1, the Direc-

tor of Information Management has acknowledged a problem in meeting mission requirements in this area.

Air Force Publication Management

The problems associated with publication management are not new. In the decision to employ computer technology to manage information more effectively, Air Force senior managers recognized the publication system as an ideal starting point. Between 1977 and 1985, the Air Force experimented with an automated electronic distribution and update system for publications and forms called PIPPS, Publishing Information Processing and Printing System (Watson, 1989:23). PIPPS used an acquired hardware/software system to establish a digital publishing data base which could be telecommunicated to all Air Force locations in order to provide on-demand printing at all locations (Watson, 1989:23). PIPPS was abandoned in 1985 because it was too expensive ($106 million plus with a 6-7 year payback) and adequate technology was not yet available to complete implementation of the entire program. However, the need to improve the publications and forms publishing system still existed.

The next attempt to improve the publishing system was directed at a smaller, yet vital piece of the publication system: the printing process. A cooperative effort between the Air Force's information management (IM) and systems command (SC) communities defined the responsibilities of

each with IM managing the printing and SC controlling the equipment. Their efforts evolved into what is known today as Air Force Automated Publishing Service Program 50-S (alternately GPO 50-S and AF/GPO 50-S) (Smith, 1990:95). Government Printing Office Contract 50-S, with Xerox Corporation as contractor, came into being in December 1987. An independent study by Major Norman L. Watson summarizes the project as follows:

> Air Force 50-S is a three year (FY 88-90), $9.3M commercial publishing services contract . . . which uses Air Force commercial printing funds (501 series) to buy the final product--a printed page not equipment (SAF/AAP). As a services contract, (as opposed to an acquisition contract), equipment costs must be kept to a minimum. Moreover, as a services contract, future changes in technology are incorporated as they occur, and Congressional requirements on contracting-out printing activities at a ratio of 10:1 are satisfied (SAF/AAP).
>
> Through it [the contract], Xerox provides pre-press, state-of-the-art electronic publishing equipment to Air Force sites and the Air Force pays a 10:1 printing-to-system ratio for the use of the equipment (SAF/AAP). Also, through it, the Air Force created its first digital (electronic) publishing data base, which is maintained by the contractor.
>
> The contract was designed to start small (i.e., with the Air Force Publishing Division) and evolve to include MAJCOM activities, base-level functions, and Air Force Reserve function. It was designed, via a Statement of Work, to incorporate regulations, pamphlets, and forms (SAF/AAP). (Watson, 1989:25-6)

The program has been so successful that according to Colonel William O. Nations, then Director of Information Management and Administration, all future plans for information management will be based on the integrated systems and relational database established by 50-S. At the Worldwide Conference of Information Managers (DESTINY) held in

early November 1989, Lieutenant Colonel Norman F. Daviess, Chief of Systems Architecture and Integration Management under the Director of Information Management, proposed an information network connecting major commands (MAJCOM's) with their respective bases (Daviess, 1990). The key issue in the proposal was to provide on-line, on-demand access to the publications database being created under 50-S. The key benefit of electronic publishing is that it allows us apply our computer resources to the digitized information database, taking advantage of computer processor speed rather than being restricted to the limits of paper-based information processing (Davis and Olson, 1985:236-65).

The networking proposal evolved into the IM Net project described in Chapter 1. SON #011-89 proposes using the database being establish through GPO 50-S to develop CD-ROM based "electronic libraries" that can make maximum use of currently available computer and communications hardware and minimize new acquisitions (See Chapter 1, Figure 1 and Figure 2 for review of process changes proposed).

The Computer-Communications System Panel combined the request for FY92 funding for IM Net with a Defense Management Review initiative which called for using CD-ROM to distribute Air Force regulations and forms. The decision on funding is still pending as of June 1, 1990 (Daviess, 1990). Projected costs and potential benefit estimates

over the first six years are shown in Figure 3 and the projections for annual and cumulative savings are shown in Figures 4 and 5 respectively.

Electronic Publishing and Libraries

As defined in Chapter 1, electronic libraries are databases of information accessible via an electronic medium, such as a computer, with characteristics such as keyword searching, ability to be updated, ability to be distributed as necessary, and ability to serve a variety of users. Electronic libraries have evolved largely as a result of the growth in computing and electronic publishing.

It is no news to the librarian we are experiencing an information revolution; that is, a rapid and thorough transformation of the ways in which information is generated, transmitted, controlled, and employed (Weiskel, 1988:38). Computing technology enables publishers to produce books, magazines, and newspapers electronically.

> Many modern publishers of reference books are making the most of changing technologies to transform the ordinary dictionary and encyclopedia into high-tech, extremely sophisticated information systems. Computers have revolutionized the production of all kinds of books, to be sure, but no where are they able to effect basic fundamental changes as radically as they have in information storage, updating and retrieval systems. (Dawson and Nixon, 1989:18)

Reference libraries have taken particular interest in the power of computer retrieval of volumes of information. Library researchers have come to expect free online access

COSTS	BENEFITS		
	HARD $$	SOFT $$	
200 SYSTEMS (AT&T 3B2) + CONVERSION	REDUCED PRINTING & DISTRIBUTION AT AFPDC	MANHOURS IN EVERY AF OFFICE	REDUCED WAREHOUSING AT BASE PDOs
$44.7 Million*	$12.8 Million**	$23.5 Million***	

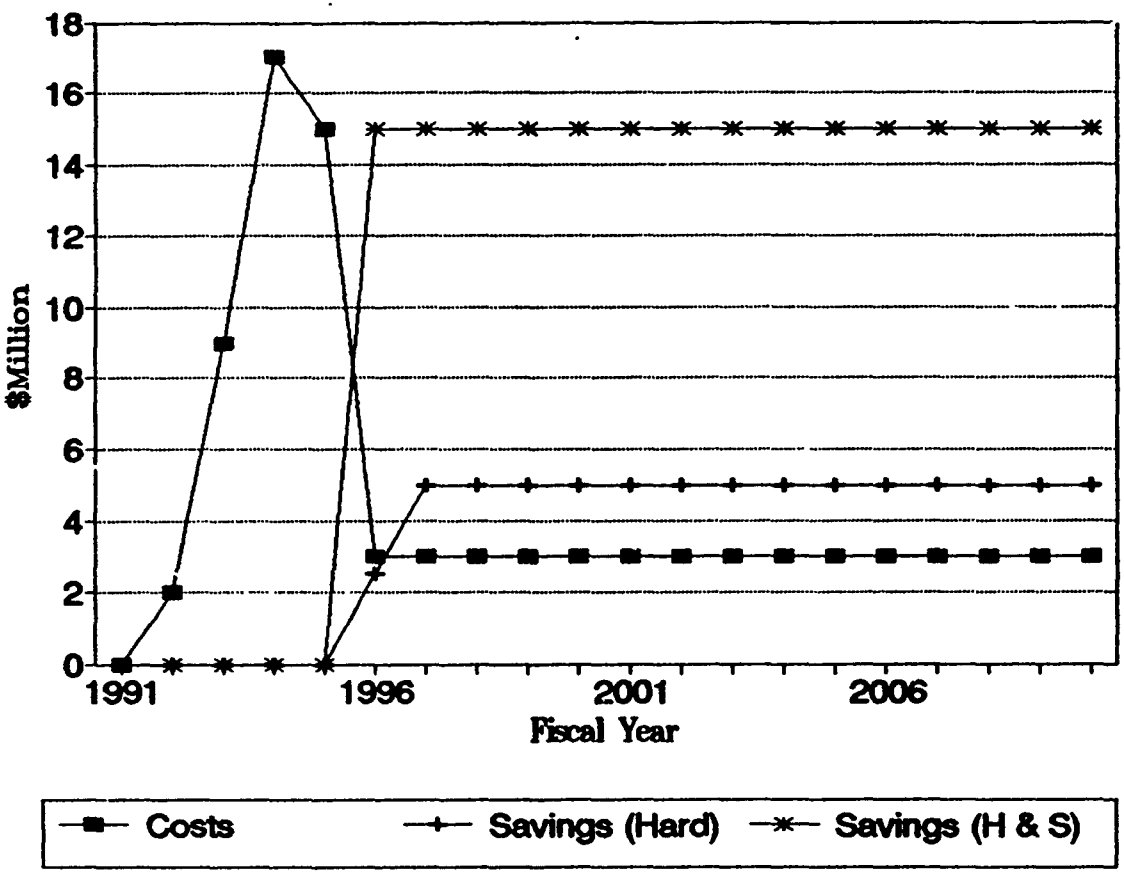
(Source: Daviess)

* SIX YEAR COST

** TWO AND A HALF YEARS OF PAYBACK, PLUS $5.1 M PER YEAR THEREAFTER

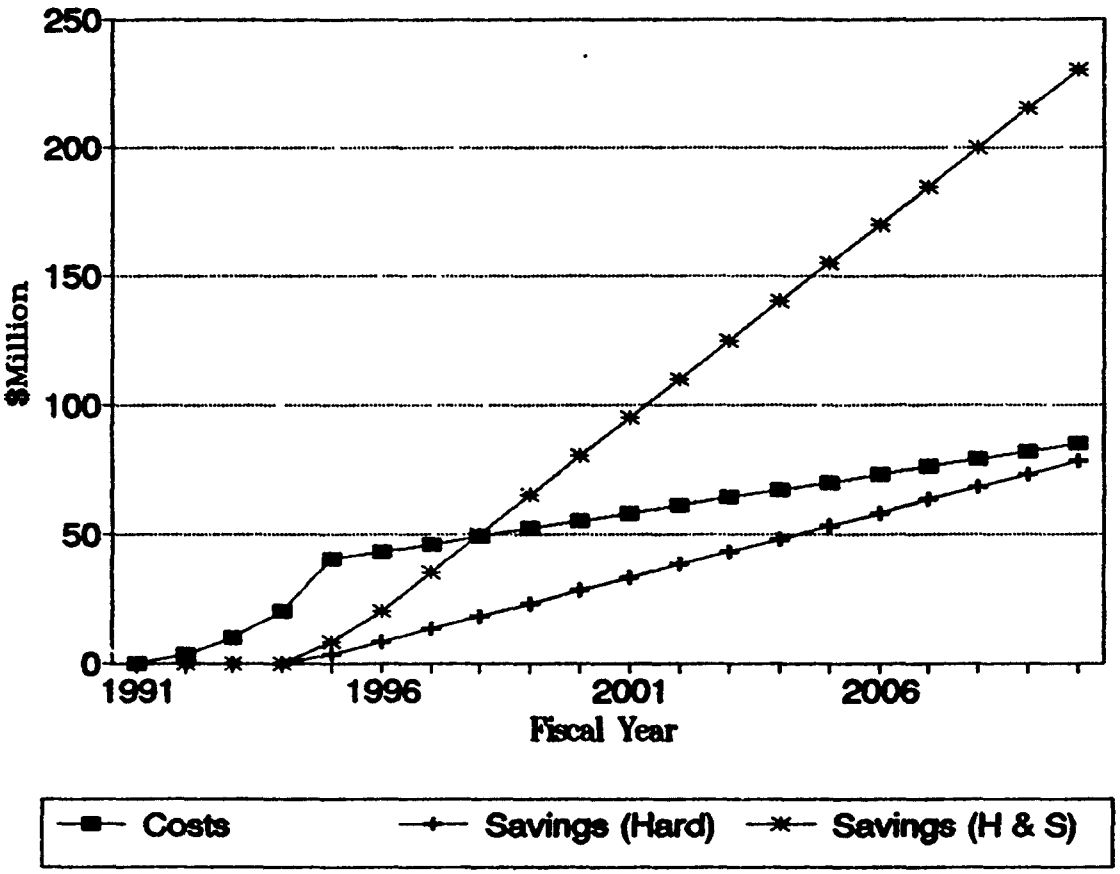
*** DUE TO NOT HAVING TO POST REGULATIONS AND HAVING E-FORMS ON LINE (e.g. SAVE ONE HOUR/MO IN 48,000 OFFICES = $9.4 M/YR X 2.5 = $23.5 M)

Figure 3. Projected Costs and Potential Benefits First Six Years



(Source:Daviess)

Figure 4. IM Net Annual Savings



(Source: Daviess)

Figure 5. Cumulative IM Net Savings

to the large online databases being created. As Joseph Esposito, publisher of the Random House travel and reference division notes:

> Peference publishing is an essential, growing part of tne publishing world. Publishing houses tend to invest more in their reference divisions because of their stability. Reference books easily lend themselves to computerization. This leads to the company's investment in automation and production. Ultimately every book in our reference division will be online. (Dawson and Nixon, 1989:18-22)

Encyclopaedia Britannica Inc. has taken a different approach and come up with a reference line that spans the publishing spectrum, and the globe. While the Encyclopaedia Britannica is arguably the best-known information storehouse, it is still available in book form. The company has diversified into a wide variety of specialty books to include Compton's Encyclopedia which was made available to schools in a multi-media form on CD-ROM in September 1989. Grolier's Electronic Publishing Division has "made its data available through online services and is developing a CD product similar to Britannica's which is due out in 1990" (Dawson and Nixon, 1989:28).

Management Issues. The impacts of electronic publishing and the information explosion that has resulted has created management problems. Weiskel points out,

> For nearly a decade now university librarians have received instruction in electronic information systems as part of their normal professional training. Not all librarians or scholars take to the technology as ducks to water, but these systems are no longer strangers or thought simply to be a fad. (Weiskel, 1988:40)

Weiskel discusses five problems brought about by technology: acquisitions and subscriptions, staff and user training and preparation, institutional and personal cost burdens, the question of equitable research facilities and access, and the problem of meaningful measures of success. For the purposes of this research we will focus on staff and user training and preparation and the problem of meaningful measures of success.

Staff and User Training and Preparation. As described above, the problem of developing expertise in the new kinds of media as tasks change affects the entire publication library staff. The users will need to be instructed as well, both with reference to the peculiarities of the university operating system and more generally with reference to the possibilities and actual techniques of electronic research. There are seven keys to successful user support programs:

1. allow users to have easy access to outside help when they need it,
2. provide adequate exploration and training for the user,
3. provide more user support when a system, such as CD-ROM, is more complex,
4. give good user support to build knowledge and skills of users and to make complex tasks seem simpler,
5. provide people as trainers rather than using printed or online sources of information,
6. give users support as to their particular needs and let them create their own network of support, and

7. give evolutionary as well as compensatory support, that is, giving background information as a frame of reference as well as answering specific questions. (Herther, 1988:121-22)

The Problem of Meaningful Measures of Success.

In addition to the question of what the university wants its library to achieve in terms of its broad educational goals, there is the more basic question, "What is the library's appropriate role in the electronic information era (Weiskel, 1988:45)?" It could be argued that the library should be judged as "successful" to the extent that is does itself out of a job. If developed properly, the on-line catalog would provide little or no reason for students or faculty to have to come to the university library itself. These ideas create an element of fear and add to the tendency to resist change.

> Ultimately the success of any information system will be judged in terms of how well it performs its expected task in direct comparison with other systems that perform similar tasks. (Weiskel, 1988:38)

In summary, computers have enabled us to provide information more efficiently and libraries are attempting to evolve with the technology. Employing new technologies such as CD-ROM to get a handle on the management of such volumes of information is not without its problems. The Air Force and libraries in general are experiencing some of the same problems and are facing the same choices as far as balancing the costs, training staff and customers, resistance by some to change, and measuring our success at

managing information during these turbulent times. We now consider the phenomenon of change, specifically information systems change, and what causes it.

Information System Change

What causes an organization to make changes tc its information system? Clearly the examples above are traditional. When meeting the objectives, goals, purpose, or mission becomes a problem and the problem can be tied to the information system--change is in order. However, when dealing with new technologies, the challenge of being "the first" or "on the leading edge" may also serve as the driving force for some organizations. These organizations have outgrown the "if it isn't broke, don't fix it" frame of mind and have progressed to a "how can we use what's available to make it better" mentality.

In research conducted by Captain Myron E. Ross, in 1987, an integrative framework to aid managers in identifying the need for change was identified. The work of David A. Nadler and Michael L. Tushman (Ross, 1987:61) served as the basis for the framework. The conclusions of the research identified "relative advantage" to be the overwhelming factor influencing information systems change. Research by Kwon and Zmud provided the organizational factors and theory behind the Ross study. Kwon and Zmud describe "relative advantage" as one of the technology factors that identify

> the degree to which an innovation is perceived as providing greater organizational benefits than either other innovations or the status quo (Kwon and Zmud, 1987:237). (Ross, 1987:27)

Review of the current literature suggests CD-ROM technology is viewed as providing this "relative advantage" to organizations which have the need to disseminate large volumes of relatively stable information in the most economical and efficient way (Helgerson, 1990:19; Halsey, 1989:57; Mortensen, 1987:28). The multi-media capabilities allow unlimited combinations of digital formats to be combined. This feature of CD-ROM will enable the Air Force to merge text and graphic databases (Hughes, 1990:SR27).

Information System Application Development and Implementation.

The fundamental goal of application development is an accurate and complete achievement of user requirements. Three approaches to developing and implementing application systems are described by Davis and Olson: contingency, prototyping, and life cycle (Davis and Olson, 1985:564). Each describes the process of system design and implementation and selection of the appropriate strategy is situational.

Development Using the Contingency Approach. The contingency approach asserts that there is uncertainty associated with requirements before and during development. During development, four contingencies affect the degree of

uncertainty with respect to achievement of an application which will deliver 'real' information requirements. These are summarized:

1. Project size. Large project size increases the difficulty of assuring that requirements are met because of the number of persons involved, the volume and complexity of communications, and changes over time in personnel. Uncertainty increases.

2. Degree of structuredness. Uncertainty about the structure of the decision process or other processes to be supported is an important factor in uncertainty about initial requirements and about alteration of those requirements during development. Uncertainty increases as structuredness decreases.

3. User task comprehension. If users have a low degree of understanding, or do not agree on the task for which a system is intended, the level of uncertainty for accuracy and completeness both in initial requirements and requirements modification is high.

4. Developer-task proficiency. [This is a] measure of the specific training and experience brought to the project by the development staff. Low developer proficiency increases uncertainty. (Davis and Olson, 1985:565)

In response to the uncertainties, organizations add control by adopting one of four assurance strategies: acceptance (accept the users statements of requirements as complete, correct, and firm and develop as defined), linear (straightforward procedures to verify conformance with requirements which are "signed off" at each step), iterative (recognizes that when uncertainty is moderately high during development, resolution may be as simple as reiterating the requirements determination process with the

user), or experimental (assurance is obtained through actual user experience with a prototype or simulation of the application). The choice of an appropriate assurance strategy is guided by the degree of uncertainty. Development success usually be assured by acceptance or linear approaches. As uncertainty increases, iteration may be required. For high uncertainty, it may be necessary to develop a prototype and experiment.

The contingency approach can be summarized as "measuring the level of each contingency, estimation of the overall level of uncertainty determined by the contingencies, and selection of the appropriate strategy" (Davis and Olson, 1985: 567).

Development Using the Prototype Approach. Prototyping is used when requirements are difficult to specify in advance or when requirements may change significantly during development. Davis describes the four-step process of prototyping to be:

1. Identify the user's basic information requirements. User describes basic needs. Designer establishes realistic user expectations and estimates cost to develop operational prototype. Data definitions and availability determined.

2. Develop the initial prototype system. The initial prototype responds only to the user's basic requirements; it is understood to be incomplete. The early prototype is delivered to the user.

3. Use of the prototype system to refine the user's requirements. The user rather than the designer decides when changes are necessary and thus controls the overall development time.

4. Revise and enhance the prototype system. Only the changes the user requests are made. Speed in modifying the system and returning it to the user is emphasized. (Davis and Olson, 1985: 569)

The advantages of prototyping are numerous and include reduced application development time to achieve a functioning system, increased ability to accomplish changes due to lower development costs, and more effective use of scarce (human) resources (Davis and Olson, 1985:570). The disadvantage of prototyping is that the system is more difficult to manage due to its frequent changes. A tendency to accept the prototype as the final product is also not uncommon.

Development Using the Life Cycle Approach. According to Davis and Olson, a significant amount of new development work continues to involve major operational applications of broad scope. The application systems are large and highly structured. User task comprehension and developer task proficiency are usually high. These factors suggest a linear or iterative assurance strategy (Davis and Olson, 1985:570). Davis describes the system development life cycle model as the most common method for addressing this class of problems. The model is characterized by well defined stages and has straightforward requirements for

deliverables, feedback, and sign-off (verification of completion at various stages).

> The basic idea is that the process by which an application is conceived, developed, and implemented is a well defined process. The life cycle gives structure to a creative process and the phases provide a basis for management control because they define segments of the flow of work which can be identified for managerial purposes and specify the documents or other deliverable to be produced in each phase. (Davis and Olson, 1985:572)

The three major stages of the system development life cycle model are definition, development, and installation and operation. The definition stage can be broken down into four phases: proposal definition, feasibility assessment, information requirements analysis, and conceptual design (user-oriented). The development stage contains the physical system design, physical database design, program development, and procedure development phases. The installation and operation stage is comprised of the conversion, operation and maintenance, and post audit phases. Davis and Olson provide insight as to the amount of effort expended during the various stages of a typical project. The definition stage consumes approximately 25 percent of the total system development effort with the information requirements phase accounting for 15 percent of the total. The development stage encompasses the majority of the effort at 55 percent with program development (which includes coding and testing of programs) making up about 25 percent of the total. Finally, the conversion phase uses

15 percent of the 20 percent total for the installation and operation stage.

In summary, we have presented three basic approaches to application development: the contingency approach, the prototype approach, and the life cycle system development approach. The life cycle system development model's importance is that "it continues to be the appropriate methodology for a significant part of new development work" (Davis and Olson, 1985:572). It also seems consistent with the tasks involved in maintaining libraries and information. Such tasks are highly structured with high user and developer proficiency. Their complicating factors are typically project size and uncertainty about the technology being employed.

Implementation of Information Systems. Since the purpose of this research was to identify "essential" success factors for an electronic library project, the findings of previous research in office automation provided insight as to potential issues to be addressed. Research conducted in 1987 by Captain Wilburn W.L. Smith on "Implementing Information Systems/Office Automation in an Air Force Environment," produced a group of five factors deemed to be associated with successful IS/OA implementation. These factors are:

1. The value of an IS/OA to an organization is subjective and largely based on perceptions of the users, and nearly impossible to measure.

2. There is little or no empirical data that can support any specific factor as being a determinant of success, only patterns or tendencies.

3. Though planning was deemed important, there was no consensus as to what strategy or determinants would be effective in planning an implementation. Simply, there are neither guidelines nor policies that are known to be readily effective.

4. The consensus of the authors surveyed found that the support of top management was necessary for a successful implementation, but there was no consensus on how top management should provide support. However, involvement in all phases was recommended.

5. There was no consensus or empirical proof to indicate that providing systems based on human factors leads to success. There is no evidence that improved user attitudes or job satisfaction lead to improved performance. (Smith, 1987:26-7)

At this point, we transition our discussion to the technical world of CD-ROM technology in an attempt to eliminate some of the uncertainty through understanding.

Compact Disc, Read-Only-Memory (CD-ROM)

Compact disc, read-only-memory (CD-ROM) is, as the name suggests, a "read-only" or fixed optical medium. Information is recorded as "pits and lands" or dull and shiny spots that are read by "shining a pinpoint of laser light less than one millionth of an inch wide" on the surface or the disc (Lind, 1987:16). The reflection is fed back to the computer as binary ones and zeros--the language of computers.

The advantages and disadvantages of CD-ROM are listed in Table 1. Noteworthy advantages include enormous storage capacity relative to size, the security of being on a fixed

medium, immunity to electro-magnetic pulse, low cost and durability. Table 2 summarizes the CD-ROM capacity equivalents, Figure 6 illustrates the relative mailing costs of 540 MB of information for various media, and Figure 7 shows the weight comparison of the various media.

The three primary disadvantages are its inability to accommodate changes due to the lack of a "write" capability, initial costs for additional hardware, and slow access speed when compared to the average retrieval time of a hard disk.

Commercially Developed Products. Electronic publishers are now making their publications available on CD-ROM. Encyclopedias on CD-ROM are available at prices comparable to their paper counterparts (Dawson and Nixon, 1989:26).

Encyclopaedia Britannica's most innovative technological achievement is its electronic version of Compton's Multimedia Encyclopedia. The entire text (and 5,000 color pictures) were put onto CD-ROM and combined with an audio track. It was designed to provide teachers with a resource to teach research and composition. Dr. Stanley Frank, Britannica's vice-president explains,

> If a student is doing a paper on presidents, he can look up Kennedy and find the article as it appears in Compton's. But he will also see a picture of Kennedy and hear one of his speeches. The program also includes a dictionary and a word processor. (Dawson and Nixon, 1989:26)

Table 1

Advantages and Disadvantages of CD-ROM

Source: Lind

ADVANTAGES

* PERMANENT/DURABLE: It is an excellent archival medium (currently Sony disks are guaranteed for 50 years). Also very rugged and able to withstand adverse weather and handling conditions.

* NON-VOLATILE: No loss or altering of data during power failures or surges.

* LOW COST: The 'per MB' cost of data is less than that of any other storage medium.

* EXTREMELY PORTABLE: The media is removable and offers portability of data.

* SECURITY: Physical control can be maintained easily and thus large quantities of sensitive data can be controlled. Also, the possibility exists to manufacture the disk out of glass instead of polycarbonate material and thus, for military purposes, emergency destruction could be easily accomplished.

* SMALL PHYSICAL VOLUME/WEIGHT: Easily carried or mailed at a very reasonable expense.

* NOT ABLE TO BE ALTERED: This media is Read Only Memory (ROM) and as such, it is extremely useful for audit trails in the legal and financial world where magnetic media have not been allowed as evidence due to the alterability of that media.

* ENORMOUS DATA STORAGE CAPABILITY: Up to 600 MB of data on a single side of a disk which is only 4.72 inches in diameter.

* USER FAMILIARITY: It is simply another PC peripheral that, to the user looks just like a read only MS-DOS disk. Also, the average user has had experience with the same physical disk in the CD-Audio environment and therefore feels more comfortable with it already.

* BACKUP IS ELIMINATED: There is no need to back up the disk because it is ROM. For safety's sake, multiple copies can be ordered at the time of disk pressing and stored in separate locations.

* ELECTRO-MAGNETIC PULSE (EMP) HAS NO EFFECT: This is not a magnetic media and therefore any sort of electro-magnetic energy has no effect on it.

* NO HEAD-CRASHES: The read-device is optical and does not contact the disk in any way; therefore, head-crashes are virtually eliminated.

Table 1 (Continued)

DISADVANTAGES

* READ ONLY: This feature, while a benefit to some is a hindrance to others desiring to alter their data.

* INITIAL COSTS FOR ADDITIONAL HARDWARE: Although this is true of any new system, it is viewed by many as a disadvantage when compared against the sunk costs of the presently installed system.

* SLOW ACCESS SPEEDS: The average time to retrieve data, when compared to hard disk is much longer.

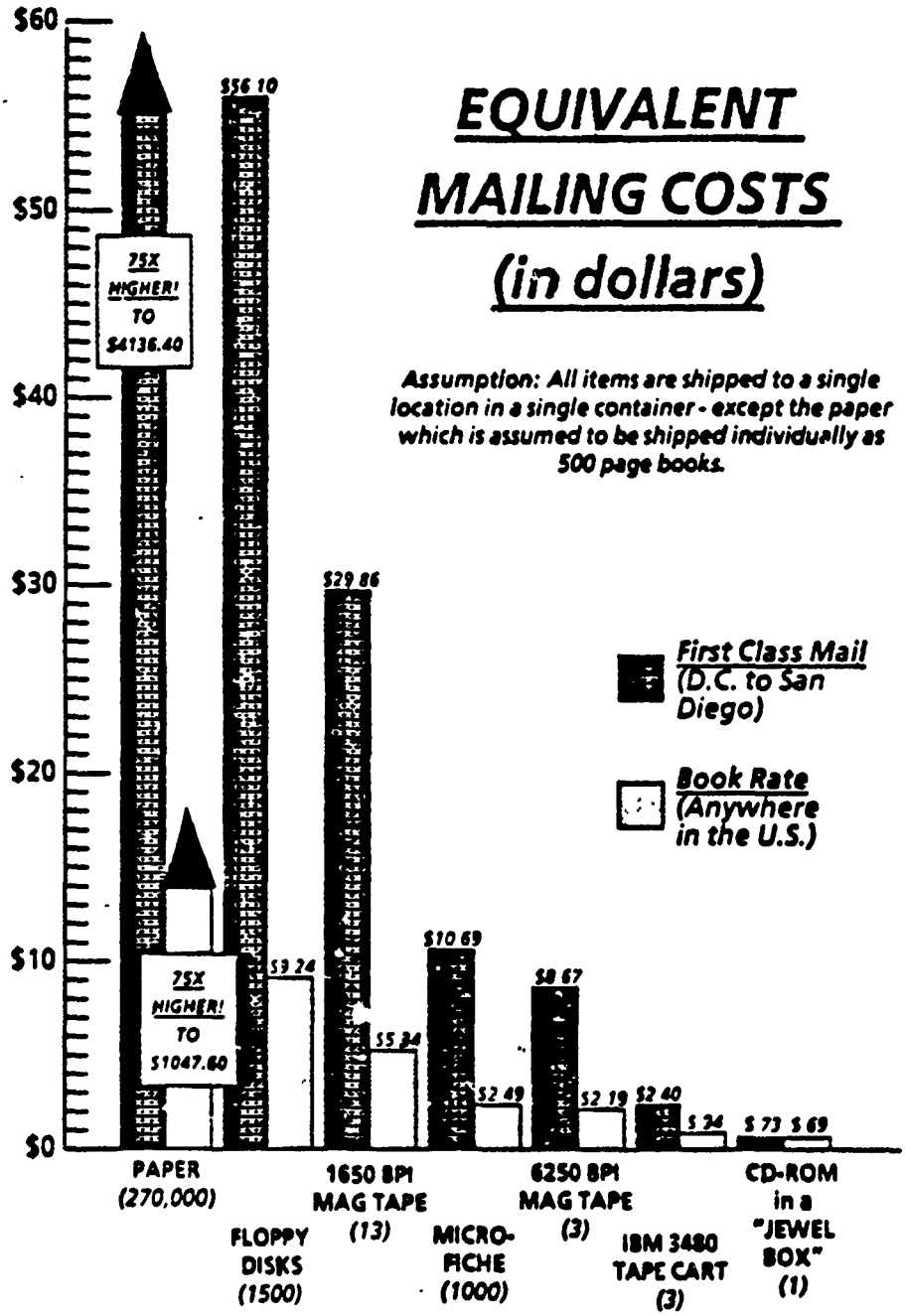
Table 2

Summary of CD-ROM Capacity Equivalents

Source: Lind

A CD-ROM Disc Holds the Same Information As:

* 270,00 Pages of Text
* 20,000 Pages of Images scanned at 300 x 300 DPI
* 10,000 Pages of 1/2 Text and 1/2 Graphics
* 1,500 5 1/4" Floppy Disks
* 1,000 Microfiche Cards
* 27 20-MB Winchester Disks
* 13 1650 Bytes per Inch (BPI) Magnetic Tape
* 10 Standard 1/2", 9-Track Magnetic Tape
* 3 6250 Bytes per Inch (BPI) Magnetic Tape



(Source: Lind)

Figure 6. Relative Mailing Costs of 540 MB of Information

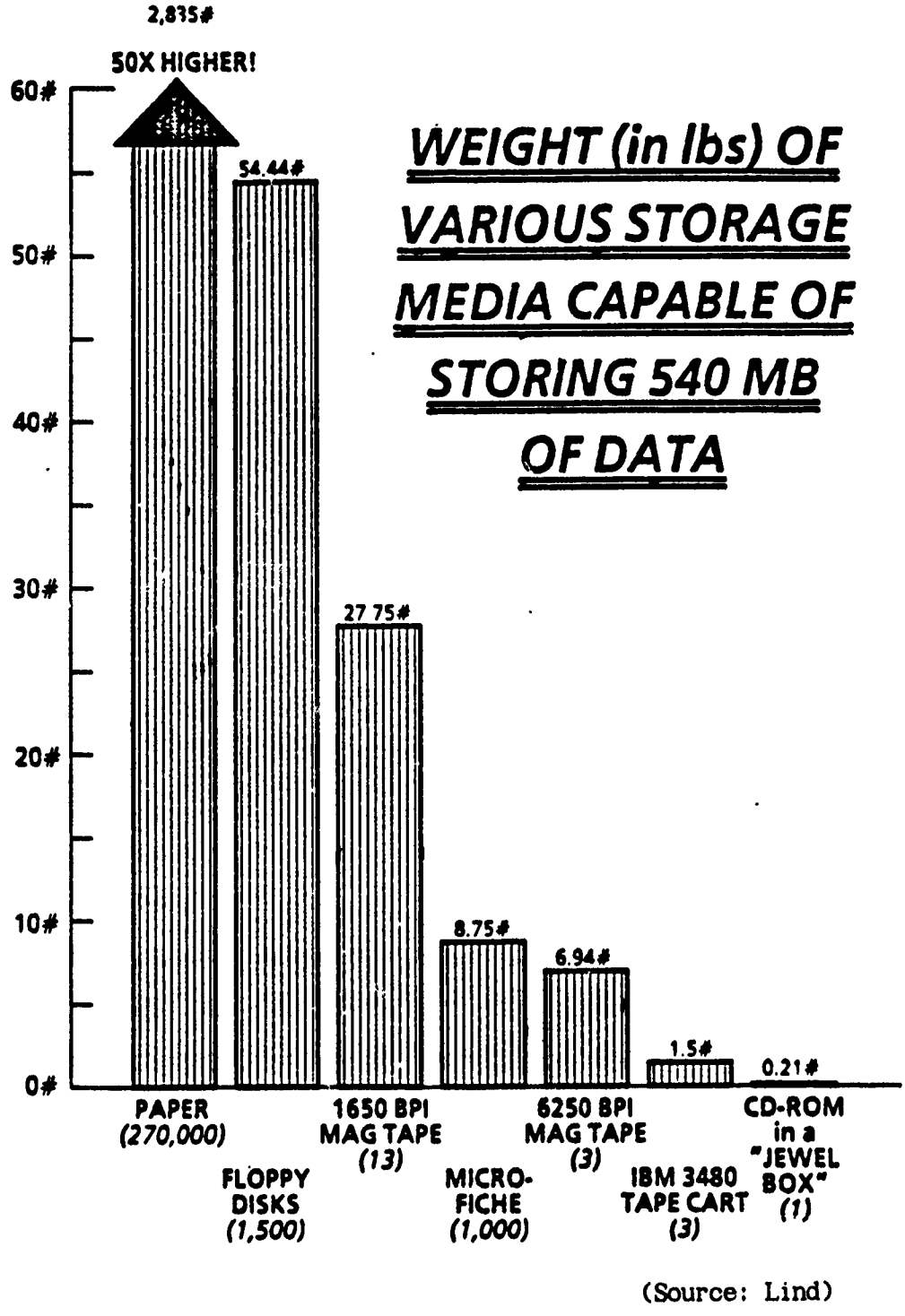


Figure 7. Relative Weight of 540 MB of Information

Commercially, CD-ROM discs are used to distribute huge databases on a subscription basis to information centers and to individual workstations. In this mode, CD-ROM is competing directly against online services and paper sources. Libraries are taking advantage of abstract services such as University Microfilm International's ABI/Inform and Business Periodicals Ondisc, Bowker Electronic Publishing's Books in Print, and The Computer Library by Ziff Communications (Halperin and Holley, 1989:29; Mortensen, 1987:28; Miller, 1989:19-20; Nelson, 1990:47-49; Bamford, 1990:58-9). CD-ROM is also being used for "in-house" publication and dissemination of information to employees. In this mode, CD-ROM databases are customized and can eliminate much of the need for high-cost telecommunication links to remote facilities. Portable systems with embedded CD-ROM drives allow workers to take digital information into the field to diagnose and repair equipment as well as taking the volumes of reference materials needed (Helgerson, 1990:17).

> Bibliographic databases, among the first CD-ROM products to come to market, are fast finding acceptance with libraries, with the Library of Congress at the forefront of the movement in developing a single CD-ROM that contains a complete bibliography of everything in their card catalog. (Holtz, 1988:2)

For libraries and organizations that can take advantage of commercially available products, the choices are many. The "Directory of Portable Databases", a new listing of CD-ROM Titles and Developers, lists over 400 titles and

contains vendor information as well as drive, software, and platform requirements for the various products. This can be particularly valuable considering there is no standard software retrieval "engine" (the key to getting around in the large databases), and although most commercial products contain the retrieval software on the CD-ROM, most will require some storage on the hard drive or in RAM. The directory thus provides information to support better acquisition decisions.

Elaborating in the introduction to the directory, William Paisley, executive vice president of Knowledge Access, Inc., provides the following "Selection Checklist for CD-ROM Publications":

1. Is the disc recorded in the standard ISO 9660 format?

   A disc containing timeless information may not be recorded in a timeless format.

2. Does the disc require special hardware or software to operate?

   A disc with unusual functions may require more RAM or hard disk memory, or it may require one or more special boards in the computer for purposes such as image decompression, display resolution beyond VGA, or accelerated printing of images.

3. Does the content meet the particular information needs?

   CD-ROM is a fixed-capacity medium providing more space than some databases require but less than others require. Filling the spaces with content the user values having will inevitably result in getting some material we don't want if the price is right for the material we do want.

4. Does the retrieval program have both a novice mode and an expert mode of use?

   The retrieval program should be easy to use quickly and casually but it should facilitate precise retrieval using Boolean logic, term proximities, wildcard terms, etc.

5. Does the retrieval program have enhanced searching features such as hypertext or post-retrieval features to work with the retrieved information?

   "Hypertext," which is actually a family of methods for moving between related sections of text, earns praise from users because of its intuitiveness. Post-retrieval features for extracting, analyzing, or transforming the retrieved information go beyond online capabilities. Such features can save the user hours of effort when the retrieved information will be incorporated directly into the document.

6. Does the retrieval program transfer information to other popular programs?

   A retrieval program should also transfer information easily to word processors, desktop publishing programs, personal database management programs, spreadsheets, graphics programs, etc.

7. Does the disc's price match its value in a particular application?

   There are various formulas for computing value, such as the displaced cost of online use or the contribution to productivity. A disc costing $1000 may be over-priced for some applications but a great bargain for others.

8. How good is the documentation and technical support?

   The users' manual and arrangement for telephone technical support should provide assurance that the disc can be made to work well.

9. Does the disc have a fair return policy?

   It is not easy to preview CD-ROM publications, nor are their catalog descriptions as detailed as possible with respect to content or retrieval features. Discs that prove to be poor invest-

> ments, once reviewed, should be returnable. (Paisley, 1990:ix-x)

In summary, there are many choices for those able to take advantage of commercially available products. The increasing number of products illustrates the willingness of vendors to produce what the customer needs and, as in the case of online services, perhaps to the detriment of their other products. The checklist provided by Paisley highlights the essential elements to CD-ROM products which will be carried over into our discussion of custom designed CD-ROM products.

Customized CD-ROM Products. Under certain circumstances commercially developed CD-ROM products are not appropriate. The nature of the information may be too unique and lack the profit incentive for vendors to invest their resources in a product which would be made available to the general public. For these specialized or proprietary databases, potential users face significant challenges in acquiring relevant information. As Richard S. Halsey, Dean at the School of Information Science and Policy, State University of New York at Albany, points out in an article titled, "Learning about CD-ROM Technology: an Educator's Perspective on Sources, Issues, Criteria, Breakthroughs, and Research":

> It is difficult for a librarian to acquire adequate knowledge about CD-ROMs because the technical, library, and promotional literatures vary in reliability, clarity, authoritativeness, and currency.

> The best insights can be attained through the technical literature, but their presumption about the reader's mathematic and engineering proficiency are prohibitive. Least dependable because of its self-touting nature are the writings affiliated with one of the anti- or pro-CD-ROM camps. (Halsey, 1990:56-7)

Based on the information gathered in this research, the author will assert that the scope of the difficulty extends beyond that of librarians and includes managers as well. According to Halsey, the best solution to the literature issue is to combine reading with observation. He strongly promotes "learning from experts" and identifies two techniques for those who want dependable guidance: interrogation and confrontation.

> Interrogation uses the skill of posing questions to solicit information that is relevant and valid, sort of verifying the credibility of the source. The purpose of confrontation is to promote discussion among two or more respected experts that generates knowledge, facts and true cost projections rather than arguments that result in the exchange of more ignorance. (Halsey, 1990:57)

Finally, a familiarity with the basics of the CD-ROM production process is essential in understanding the issues facing organizations considering development of their own application. There are five steps to CD-ROM manufacturing:

1. Data Generation. Data generation is the process of setting up information for maximum accessibility. This step is usually carried out by the customer or information provider. In this initial step, all material is recorded on magnetic tape and is organized so that it can be easily accessed. During this process, a developer organizes a list of key words subject to search and retrieval procedures.

2. Data Preparation. This step requires that material be organized in logical files that describe the disc layout. The data is then copied onto magnetic tapes, which are used in the next step.

3. Pre-Mastering. This step consists of adding control codes for synchronization, address/mode indication, error detection, and correction. These codes are combined into individual CD-ROM format sectors. When sectoring is complete, the master disc can be produced.

4. Mastering. This step begins by encoding information into the final CD-ROM format. Information is then recorded optically on the photo-chemical-coated surface of a glass disc. Following successful developing, the disc passes through an evaporation stage where it receives a thin silver coating. The disc master, carrying all the data in the form of billions of micro sized pits, is then ready to make stampers and discs.

5. Replication. Replication is a four-stage process. By a galvanic method, the disc master is transferred onto a nickel stamper or "mother." Using the same process, a number of positives or "daughters" are produced. From each of these, several stampers are made. Using injection molding techniques, these stampers are then used to replicate the desired number of CD-ROM discs. Finally, each disc is given a reflective metal coating that is then covered by a protective layer of lacquer. The label is added to the lacquered side of the disc. (Holtz, 1988:3)

Typically, the client is involved extensively in the early stages of the process and the importance of this involvement is widely espoused (Bashir and Elmore, 1990:53; Dreiss and Bashir, 1989: 2-7; Sherman, 1988: 345-46; Bonner, 1990:66). Recently, the equipment and software for "in-house" pre-mastering has become available at prices that make it beneficial to "raise your investment and involvement" in lieu of hiring an outside service bureau to produce your application from start to finish. The bene-

fits are twofold: generally there is a decrease in the cost and an increase in control over how the database is built, the features of the interface, and the general quality of your application (rome, 1990:68).

Although a checklist for successful development of a CD-ROM application was not found in the literature, a few items stand out: the importance of the retrieval software emphasized by Paisley, the difficulty of obtaining accurate information as noted by Halsey, and the importance of user/client involvement as noted primarily by Bashir and Elmore. Having gained a feel for what CD-ROM development entails, one realizes the need for and importance of this research.

Local Area Networks. The advent of local area network technology with the potential for sharing resources via an optical server is a driving force behind commercial CD-ROM application development (McQueen, 1990:92). However, potential problems with CD-ROM networking exist and are by no means trivial. They include:

1. "RAM CRAM" as a result of loading all of the necessary networking software at the workstation.
2. Networks are initially (first two to three months) unstable.
3. Too many users on the network and/or too many users accessing the CD-ROM drives can cause loss of performance.
4. Some applications have many revisions. While the commitment of the publisher to enhance and improve the products is admirable, it can be difficult for clients to maintain and decreases productivity.

5. Those with terminals as opposed to microcomputers have very limited options at this point.

6. For an optical server operating system to run on your LAN, it must provide a compatible communications protocol. Many Netbios-based LANs exist today, but beware: some Netbios products are inferior (slow, require much memory, etc.). (McQueen, 1990a:92; McQueen, 1990b:62)

Other Optical Technologies. As mentioned earlier, CD-ROM is only one of three types of optical discs. Videodisc technology is also read-only and is used primarily in education, training, and merchandising displays. It is used to store large amounts of analog data such as photographs, slides, film or tape segments, and computer-generated text and graphics. The images are displayed on a television monitor, and the interaction among images is controlled by a microcomputer.

Write-Once Read-Many (WORM) optical discs allow the user to record information onto a disk at a local work site and read the stored and recorded data as required from the disk. A WORM drive is both the mastering system and the delivery system all in one (Helgerson, 1990:18). WORM discs are most appropriate for storage and are very popular for archival data.

Erasable optical disks and drives have only been available since 1988 and can store 650 or 1,200 megabytes of data. The erasable disks are in direct competition with current storage devices with added benefits of removability, safety from electro-magnetic disturbances, more

than acceptable data transfer rate and access speeds, and comparatively low price. The benefits can resolve many storage problems for automated offices (Helgerson, 1990:18).

Summary

The changes felt as a result of technological advances continue to impact all aspects of our environment. The environment for this research is the information environment. The literature enables one to look forward to what is to come in the areas of electronic libraries, Air Force libraries, and information systems development. Optical disc technology is already playing a large part in electronic publishing and promises to grow as a prominent future mean of recording, storing, and distributing information.

In Chapter 3, the methodology for answering the research questions will be discussed. The questions "What was done?" and, "Why?" will be answered.

III. Methodology

Overview

The literature review provides information about successful development and implementation of information systems. Libraries, viewed as a subset of information systems, could conceivably take on some of their characteristics. The current research explores electronic library projects and attempts to identify, through structured interviews, the applicability of information systems theory in identifying "essential success factors" as well as any factors unique to "electronic libraries."

Research Methodology

An exploratory study was conducted by interviewing ten program managers who had developed and implemented electronic library projects. Electronic libraries have become possible largely due to advances in computer technology and represent, therefore, a rather new topic in the area of information systems management. In attempting to define what constitutes research, C. William Emory discusses "applied" research:

> The classical concept of pure research does call for a hypothesis, but in applied research such a narrow definition omits at least two types of investigations that are highly valued. First is the exploratory study in which the investigators know so little about the area of study that hypotheses have not yet emerged. An equally, if not more important area of study is that which the purists call, "merely descriptive." It deals with the discovery of answers to the who, what, when, where, how questions rather than the why questions.

> The purpose of the research can be defined by their immediate communication objectives. The four basic types of studies are reporting, description, prediction, or explanation. (Emory, 1985:10)

This study is primarily descriptive in nature in the sense that it "seeks to make a profile of a group of problems." At the same time, it is predictive in that it tests the validity and applicability of general information systems theory. The research was modeled from a similar study conducted by Magal, Carr, and Watson in 1986 which attempted to identify "Critical Success Factors for Information Center Managers ." The information center (IC) research by Magal et al. attempts to expand the applicability of the critical success factor approach (CSF) espoused by Rockart (Rockart, 1979). This approach focuses attention on areas where "things must go right" if the organization is to be successful. "While several researchers had explored CSFs for IC managers, they had not considered whether these CSFs were equally important or relevant to all ICs (Magal et al., 1988:413)."

> The IC research consisted of a field study to develop the research questionnaire, a pre-test of the questionnaire with 11 IC managers, and a survey of 1,490 randomly selected subscribers to Information Center magazine. (Magal et al., 1988:415)

Similarly, this study involved the development of a research questionnaire and a pre-test of ten program managers who have developed and implemented electronic libraries.

Questionnaire Development

In viewing electronic libraries as a subset of information systems, the life cycle model was used to formulate questions that would identify the applicability of general information systems theory. While libraries are not equivalent to "information centers" as defined in the Magal et al. study, both are attempting to respond to the need to support end-user computing. The IC study employed Nolan's Stage Theory (Nolan, 1979) as a basis for development of their questionnaire since it "seems logical that ICs go through stages of growth" (Magal et al., 1988:413). The result of the IC study was a list of 26 critical success factors. They were rank ordered and a composite analysis was conducted. The results are listed in Table 3 and served as the primary basis for the questionnaire used in this research. This basis was supplemented by analyzing the differences in information flow resulting from the change of media involved in implementing "electronic libraries." This analysis was conducted by comparing the current information flow (Chapter 1, Figure 1) with the future information flow (Chapter 1, Figure 2). The comparison helped to ascertain what factors (if any) might be unique to the technology being implemented.

Formulating the questionnaire to: 1) incorporate as many of the potentially relevant factors as possible, 2) maintain a reasonable time frame for a telephone interview, and 3) provide the information necessary to answer the

Table 3

Summary of Results of Information Center Study (1986)

Source: MIS Quarterly

Factor 1:		Commitment to the IC Change Concept
CSF#	6	Top management support
	8	Promote IC services
	14	Organizational acceptance of IC Concept
	20	Commitment of end users to the IC Concept
	21	Career paths for IC staff
Factor 2:		Quality of IC Support Services
CSF#	2	A competent staff
	3	Support software packages
	4	End-user training
	19	Reliability of applications developed
	24	Standardized hardware and software
Factor 3:		Facilitation of End-User Computing
CSF#	9	Communication with users
	10	Cost-effective solutions
	11	Atmosphere for users
	13	Understanding user's business and problems
	15	Manage end-user expectations
	26	Liaison function with end-user departments
Factor 4:		Role Clarity
CSF#	16	Provide services to distributed sites
	17	Define IC mission
	18	User understanding of data processing
	22	Chargeback criteria
	23	Control procedures to ensure standards, policies, etc. are adhered to
Factor 5:		Coordination of End-user Computing
CSF#	1	Priority criteria for work
	5	Monitor and coordinate end-user applications development
	7	Respond to applications requests
	12	System performance

Note: CSF# is the overall rating of the CSF based on the Mean Level of Importance

research questions proved quite challenging. To facilitate the interview, the researcher organized the questionnaire so that the respondents were basically reflecting upon the project development process in the sequence it occurred. When possible, questions were quantified by providing a 5-point Likert scale, and a copy of the questionnaire was provided the day prior to the telephone interview.

The interview began with broad questions such as "What prompted your organization's interest in CD-ROM technology?" and "How was the technology expected to support the organization's overall goals and objectives" (Ross, 1987:61; Helgerson, 1990:19; Mortensen, 1987:28; Halsey, 1989:57)?

Once the "why" questions were addressed, the research questionnaire proceeded with the "how" questions such as "Was a formal plan for the project developed?" and "Briefly describe the project's 'benchmarks.'" The issue of planning was not specifically addressed by the IC research, but was identified by Captain Wilburn W.L. Smith. Though planning was deemed important in his research, no consensus on strategies or determinants emerged as "effective in planning and implementation" (Smith, 1987:26). Planning is also viewed as a critical component of project management (Meyers, 1984:145; Davis and Olson, 1985:293) and therefore warranted further investigation. In this section, the researcher also probed for factors which might have influ-

enced the planning process. Examples include the boss's and user reaction to the project "idea", the managers perceived risk, perceived value of information to the organization and the specific value of the information addressed by "the projects", and user involvement. These questions were based on the information and theory described in the last three sections of Chapter 2. A copy of the questionnaire is provided in Appendix B for further details regarding the specific issues addressed.

After the "how" questions were covered, the researcher queried the project managers as to their "measures of success" for the projects. These questions were pursued as a result of Smith's research findings and the observations of Weiskel (Smith, 1987:26-7; Weiskel, 1988:45). Issues such as the extent to which goals/objectives were met, customer satisfaction, boss's satisfaction, improved effectiveness, and increased usage and productivity were evaluated in recognition of information systems theory as summarized by Davis and Olson (Davis and Olson, 1985:604-24). The respondents were then tasked to rate how they perceived their bosses and users would rate the project's success. Finally, the project managers were asked to offer their own evaluation of the project's success.

In an attempt to summarize the activities of the interview, a final section was included to allow the respondents the opportunity to reflect and place in perspec-

tive the issues covered. The project managers were asked to rate the importance of previously described "important" factors on a continuum from "Not Important" (0) to "Crucial" (10). This "review" question helped to force them to consider each factor's importance with respect to the other factors discussed. The results facilitated a translation of the responses into a rank order similar to that of the Magal study. Finally, the respondents were asked to comment on a "Case Study" which briefly described the Air Force's IM Net proposal. This would supply some of the information necessary to answer the second research question.

A preliminary version of the questionnaire was pretested on one subject. One question was added and two were modified for clarity. The question that was added was the "review" question described above. It had initially appeared that the interviewee could "fire-wall" (rate everything as "Very Important" or "Crucial") the items independently, providing only limited information to the research. However, by providing a means of evaluating these questions on a continuum relative to each other, the responses reflected a view of their overall importance to the project's success (See Appendix B item 48). Further verification was made by comparing the success factors obtained with those identified by Magal et al.

The questions concerning aspects unique to electronic libraries and CD-ROM development were derived from the available literature, various CD-ROM presentations at FOSE '90 (a computer trade show), CD-ROM working group (SIGCAT) newsletters, conversations with CD-ROM developers and users in general, as well as by analyzing the current and future information flows of the IM Net proposal (Figures 1 and 2 in Chapter 1). Appendix C identifies the various points-of-contact who provided background information formulating the author's understanding of CD-ROM technology and potential applications. In the author's opinion, this was the most difficult task in the research for the very reasons mentioned by Halsey and reported in Chapter 1 and 2: the variability, reliability, and accuracy of the literature as well as establishing the credibility and intentions of the "experts" (Halsey, 1990:56-7).

Having created what can be described as "a general purpose" questionnaire (Appendix B), the next task was selecting the subjects for interview.

Interview Subject Selection

Refocusing on the first research question, a set of operational criteria was developed based on the definition of electronic libraries as stipulated in Chapter 1 and the characteristics typically associated with them. Table 4 provides the evaluation criteria for the subjects. A

Table 4

Interview Criteria for Subject Research Projects

1. Primarily Textual Information
2. Some Graphics
3. Ability to Search on Keywords
4. Large Volume of Information (10,000 pages or more)
5. Wide Distribution
6. CD-ROM and Microcomputer
7. Development
8. Implementation

matrix was then created which evaluated potential candidates for interview based on the extent to which their applications met the criteria (See Appendix D). Potential candidates were identified from a variety of sources to include current journals, periodicals, and referrals from contacted individuals. Organizations meeting at least four of the criteria were contacted and their project managers identified. At this point, some basic questions were asked to ascertain the status (development and implementation) of the project and a brief description to find the projects that would provide a "close fit" to the Air Force's IM Net project. In consideration of the second research question and the applicability to the IM Net project, many of the popular and more developed CD-ROM application projects were eliminated due to their emphasis on developing graphics

applications. Of the thirty-four candidate subjects initially considered, ten were ultimately selected. Managers and developers alike were very helpful in the development of the research questionnaire as it applies to CD-ROM application development issues (See Appendix C).

Many of the candidate projects were in various stages of development and very few had achieved implementation. Since complete implementation proved too restrictive to allow sufficient subject selection, candidates in the latter stages of development were included.

Although not specified as a criterion, it was the intent of the research to obtain a certain amount of diversity among the subjects. Therefore, the candidates were additionally screened in order to provide a somewhat "stratified" sample of industry and government. The final subjects included three private enterprises (Mead Data Central, The Coca Cola Company, and Arthur Andersen & Company), three projects associated with the Navy, two Air Force projects, one federal agency, and one public library. A summary of the projects is provided in Appendix E.

Success

The selection of candidates was not based on determining the success of the projects at the outset. Unsuccessful projects can often provide as much, if not more information about what is needed to succeed. As previously

identified, success is subjective and often "impossible to measure" (Smith, 1987:26-7).

The initial contact with each of the research subjects involved a self-assessment as to the project's success. Note here the research does not attempt to assess the degree of success. One of the findings in the research conducted by Smith in 1987 indicated, "There is little or no empirical data that can support any specific factor as being a determinant of success, only patterns or tendencies" (Smith, 1987:26). The popularity of management by objectives over the last twenty years has resulted in the prominent means of evaluating success as "the ability to achieve predetermined objectives or a specified plan" (Halbrecht, 1977:1).

Interviews

Interviews of the subjects were conducted over the telephone, except for the in-person interview with Mead Data Central which is headquartered in Centerville, Ohio. Considering the military budget situation and the varied locations of the subjects, telephone interviews were viewed as the most efficient means of obtaining the necessary information. Due to the length of the questionnaire and to facilitate those questions that were mere ratings, a copy of the questions was telefaxed to the interviewee the day prior to the scheduled interview. The interviews averaged one and one half hour in length, with the longest taking

two hours and twenty minutes. Subjects were asked if they had any questions or problems with the questionnaire prior to the interview. The most frequent response was that parts of the questionnaire did not appear to be applicable to their project. This was not unexpected. As previously mentioned, the questionnaire was designed to serve multiple purposes in response to the diversity of the sample. Therefore, these questions were simply marked not applicable or N/A for that subject.

Data Analysis

The data analysis attempted to group the responses to determine whether a particular factor was deemed "essential" by a majority of the subjects. Many questions involved rating an item's importance. These were considered relative to the objectives of the project, the current status of the project, and additional comments made during clarification or discussion of the item. Thus the data were integrated both quantitatively and qualitatively in an attempt to identify the "key issues." The themes which emerged as predominant or consistent are highlighted in the discussion of results in Chapter 4.

Summary

This chapter contains the description of the methodology used to answer the research questions. Structured interviews were conducted with ten project managers who had developed and implemented electronic library projects.

Secondly, the process of developing the questionnaire used to guide the interviews which would attempt to capture the "essential" factors for success was explained. The description of the selection process followed as well as how "successful" development and implementation was determined. Finally, the interview process itself is described.

The next chapter will present the results and analysis. The purpose is to describe what was reported in the interviews and integrate this with what is suggested by the theory.

IV. Results and Discussion

Overview

The purpose of this section is to present and analyze the information obtained in the interviews with the subjects described in Chapter 3. First, a description of the various projects suggests some general implications. Next, we present a review of the subsections of the interview questionnaire and a discussion of the interviewee responses. Finally, we relate the interview responses to the theory discussed in Chapter 2.

Project Descriptions

Appendix E provides a summary of the projects used as interview subjects in this research. The summary includes the associated program managers, companies, company budgets, developers involved with the project, hardware and software vendors involved, the project names, and brief descriptions of the projects and project dates. The following paragraphs present some highlights of the various projects.

The most established projects are from the commercial sector. Arthur Andersen & Company has implemented accounting manuals on CD-ROM for use by their field auditors using portable microcomputers with CD-ROM drives. The system was first implemented in May 1987. Mead Data Central was able to provide its Denver subsidiary, MicroMedics with a CD-ROM replacement for their microfiche database on poisons and

poison control procedures for use in hospital emergency rooms. This application was also implemented in 1987. The two Air Force projects, DEARAS and MALS, and The Coca-Cola Company policies and procedures project were started in 1987. The Navy "paperless ship", Army Corps of Engineers, Naval Research Laboratory Library, and Howard County Library projects were begun in 1988. The Navy also has the newest project on the list with the Aegis Optical Technology Project, designed to enhance training, which was initiated in May of this year.

Five of the ten projects were implemented in less than one year. The WORM project at the Naval Research Library began implementation in just over a year. The Navy "paperless ship" project took approximately two years to begin implementation while The Coca-Cola Company is trying to beat the three year mark with implementation in October 1990. The Air Force DEARAS project is expecting to initiate a contract in September 1990 for implementation in fiscal year 1991. Finally, the Navy's Aegis Optical Technology Project is planning implementation within two years.

Why do some projects take longer than others? Data conversion was the primary reason given. The organizations that have implemented in one year had data that was already in an electronic format or in a format that was easily converted (Arthur Andersen & Company and Mead Data Central both had electronic databases). For some, the U.S Army

Corps of Engineers for example, the conversion was not easy. With all their data on paper dated anywhere from 1955 to present, there were print quality as well as format problems. Their solution was to OCR (optical character recognition) scan and raster scan to produce exact duplicates of the paper products (parallel system) which allowed for easier quality control checking. Additionally, the indexing was kept to the simple indexes provided by the paper products. The goal of this project was to save printing, distribution, and storage dollars. The use of improved scanning technology in the second phase of the project will expand the indexing capability. The key point here is that the time to implementation is greatly influenced by the data preparation required and how searchable you want to make the product. According to Arthur Andersen & Company's representative, approximately 85 percent of CD-ROM development effort is data preparation.

Of the ten projects, three have not been implemented. Two have proven prototypes and are awaiting funding and the third is in development. Of the two WORM projects, the Navy "paperless ship" is using WORM for the initial prototype and to create the master a project for CD-ROMs which will ultimately be distributed Navy-wide. By contrast, the preservation of unclassified reports by the Naval Research Library is too large for CD-ROM and the archival nature of the project makes WORM the more appropriate medium.

The budget question seemed to be the most sensitive of the questions asked. The figure reported in Appendix E is the company's budget for 1989 or the revenues reported that year. The figures range from just over $1 million to several billion dollars. It was interesting to note later in the interview that budget was viewed as not important by 50 percent of the subjects.

Considering the fact that CD-ROM drives and applications have only been in use since 1985, the majority of the interviewees described themselves as being on the "leading edge" and aspiring to gain the advantage by putting technology to work for them. Admittedly, mistakes were made along the way and the following sections will elaborate on what the "experts" believe it takes to make it work.

Discussion of the Interview Results

Appendix F provides a detailed summary of the interviews conducted for this research. Below are the highlights of the subsections of the interview questionnaire.

Goals. All interviewees identified the need for specific goals/objectives to be very important or crucial. In describing the goals of their individual projects, eight of the ten have as a goal to reduce cost or improve access to information or both. The other two view exploring new technology and potential applications as their goal.

In rating the importance of various issues in their projects' initial considerations, computer searching was identified by 70 percent of the interviewee as essential with 20 percent identifying it as important. The second issue resulted in a tie between having the data already in "convertible" form and wide distribution. For both issues, forty percent identified them as essential and forty percent as important. Large volume of text was the third issue with 40 percent identifying it as essential and 20 percent identifying it as important. Availability of supporting technology ranked fourth in consideration with 30 percent identifying this as essential and 50 percent as important. Seventy percent of the interviewees described data update frequency as an issue that received at least important status in their initial considerations.

The least important consideration identified by the subjects was "reducing online costs" with 70 percent identifying it as not considered or considered, but not important. Only the Coca-Cola Company identified this as essential in their project's initial considerations. It is also interesting to note that this was the only instance in which they deviated from the consensus with regard to the relative importance of goals.

Background. The "Background" portion of the interview was intended to provide insight concerning why the subject projects were initiated and pursued. Each project

had its own reason for looking at CD-ROM and each manager had a particular vision as to how this could support the organization's goals.

The Naval Sea Systems Command had tons of paper technical manuals taking up space and weighing down the ships. CD-ROM offered reduced costs in the form of weight, storage, and printing, as well as improved distribution and access with retrieval software. WORM and paper alternatives were considered, but WORM technology was not as well developed and was more expensive than the CD-ROM option.

Arthur Andersen & Company needed a better way to supply field auditors with reference materials. The paper products were bulky and required users to spend a lot of time locating their desired information. CD-ROM allowed the information needed by auditors to be more "portable" and greatly improved their access to relevant information with the aid of search and retrieval software and graphical user interface software. Additionally, CD-ROM provided the data integrity which was not offered by alternative technologies, yet was essential to the product's success.

The representatives of Mead Data Central were mixed on their feelings about CD-ROM, and their loyalty to online services was apparent throughout their responses. Their client asked them, as electronic publishers, to convert a microfiche database to CD-ROM. Search and retrieval software provided the value-added "intelligence" to a relative-

ly "dumb" database thus improving access to the information. Staying with online service was considered as an alternative, since local availability was essential. The interviewees perceived an advantage of CD-ROM in search ability, but no cost benefit over online services.

The U.S. Army Corps of Engineers was looking specifically for ways to reduce costs. CD-ROM offered the required storage capacity in addition to savings in printing, storage, and postage. No alternatives were considered and extensive searching was not a consideration. Graphics were an issue and the capacity of CD-ROM offered "just what we needed."

Headquarters, Air Force Legal Services in Denver has an online database, but needed a way to make it portable for emergencies. The system needed to operate as a stand-alone without the need for telephone communications access. A prototype was developed on video disc three years ago, but was deemed too expensive at the time. Since then, the organization has been waiting for technology to provide something with the capacity to handle the size of the database required. WORM was considered as an alternative, but they did not require the capability for frequent updates. In addition, WORM technology was not as well developed as CD-ROM.

The Coca-Cola Company wished to create an electronic set of company policies and procedures which could be made

available to the company's employees. As their representative stated, "Our company is very slow to respond to technology, so I really had to do my homework to find out what was possible." All possible alternatives from removable hard drives to erasable optical discs to satellite links were considered. The long run need to create a transparent interface between the company's mainframes and microcomputers and eventually to all personnel prompted the selection of CD-ROM as the vehicle for change in the corporate culture.

The Aegis Training Center was tasked to assist with the "paperless ship" idea and make it work. The storage and updating problems of volumes of paper information common to ships were also a problem for the training center library. The greatest challenges were to integrate training center activities with interactive video, light pens, and touch screens and to develop a prototype for interactive technical manuals which incorporated the Computer Aided Logistics Support (CALS) standard. CALS was created as a result of a Department of Defense (DOD) initiative to improve the flow of acquired information through the use of electronic media and interfaces. All storage media offering the large storage required for the technical manuals were reviewed, but "right now CD-ROM has the capability for the price."

The Ruth L. Hooker Naval Research Library was concerned about losing many unclassified research reports as a result of higher priority documents needing the limited storage space. If another medium or a new location were not found the reports may have been destroyed. The volume of information and the desire to preserve and store the reports for future access by scientists and researchers prompted the decision to pursue WORM as the storage medium. The reports are currently accessed by the Library of Congress accession number. A future goal of the project is to expand the search capability. Another goal is to network the system to workstations and expand the availability of the reports to researchers.

The Howard County Library has a unique situation in that their project evolved largely as a result of corporate grants becoming available. The long range objective of the library is to use technology to enhance library operations and services. The grants made feasible a proposal for networking multiple CD-ROM databases. The only alternative approaches considered were expanding online services or using CD-ROMs as stand-alone systems. However, the networking concept would allow the database resources to be shared among many users simultaneously if necessary. CD-ROM selection was based on the availability of commercial databases which would improve their customers' access to information and hopefully reduce online costs.

Plan. The theory discussed in Chapter 2 would suggest that planning is important to the success of a project and the interviewees confirmed this with 70 percent identifying it as crucial to project success and the other 30 percent identifying it as important.

Two of the projects did not have a formal plan. Since exploratory research was its goal, the Air Force acquisition project focused on creating different CD-ROM versions of the database with different retrieval software and surveying their users for comments. The WORM project manager at the Naval Research Laboratory Library stated they knew what they wanted to do and there simply were not many alternatives, so they gathered their available resources "human and otherwise" and "gave it our best shot." So although they rated planning as "crucial", their other responses reflected pursuit of a predetermined plan rather than extensive formal planning as part of the project activities.

Plan development time ranged from three and one half weeks to three years. All described the first prototype as testing the water, but two were committed to full implementation from the beginning. Most asserted that they had accurately identified their users with the corps of engineers, corporate policies and procedures, and library networking projects identifying ultimate interests which extended beyond the intended users. In other words, addi-

tional uses and users were identified as the projects evolved which promoted expansion of the projects and increased usage.

Fifty percent of the subjects emphasized that their projects were intended to support the user/operators and not management. Fifty percent indicated that their projects were not expected to change the organization. Of the four project managers who acknowledged an expectation of changing the organization, three expressed it in terms of improved efficiency. The remaining project identified computer keyboarding as culture shock for its European managers, who viewed it as a secretarial function and demeaning in nature. The manager of Project G speaks of soliciting "conspirators" from within the ranks to serve as the trainers and emphasized their importance in successfully overcoming the attitude and changing the culture as a big factor in the project's overall success. Project C reported that changing the organization was "not applicable" to their situation.

Overall, initial response to the proposed projects was reported to be enthusiastic. Mead Data Central, the Air Force, and the Navy acknowledged the existence of concerns and/or apprehension at higher management levels. Only one group of program managers described their own initial response as other than enthusiastic: Mead Data Central representatives indicated that their initial reaction was

mixed. Thirty percent of the respondents related their users' initial responses were mixed.

Some of the particularly interesting responses dealt with the program manager's perceptions of risk. Forty percent reported that they considered the project risk to be high due to short time frames to develop and implement, being able to define what CD-ROM's actual capabilities were, the company's slow response to technology, and inexperience with and lack of development of WORM technology. While the magnitude of risk was rated rather high, risk received the lowest rating in terms of importance relative to all other factors.

All respondents reported that the importance of information was considered to be high relative to other resources and that the information provided by this project was viewed to be high relative to information in general.

Plan Development. Sixty percent of the project managers identified management support as crucial and the remaining 40 percent reported it to be very important. Sixty percent stated they received total support from senior management with clearly defined goals/objectives. The Navy's Aegis project reported no support with regard to goals and objectives and the Air Force's MALS project reported only necessary support. Similarly, sixty percent of the respondents related they received total support in the form of senior management providing resources and being

open to suggestions. Only four of the ten stated that senior management's support was equally evident through promoting participation.

Seventy percent of the respondents identified developer competence as crucial with 20 percent considering it to be very important and 10 percent considering it important. Six of the ten developers were rated as "Good" or "Great" in their responsiveness to questions with one receiving a "Poor" rating. Eight developers were viewed as "Great" or "Good" at identifying sources of difficulty while one received a "Poor" rating in this area. Six developers received a "Good" or "Great" rating for timely modifications with two developers receiving a "Poor" rating. Documentation clarity and training support were rated as "Great" by four of the project managers.

Three of the ten project managers reported "User Involvement" to be crucial and five reported it to be very important. One of the ten (WORM project at Naval Research Laboratory Library) responded that this was not important.

CD-ROM Development. Each of the respondents identified something different in response to the question of "most problematic aspect of conversion process to CD-ROM." Some related the actual process of scanning to be problematic, others specified the inconsistency in data format standards, and others related the poor quality and time involved in converting 100 percent paper format to digital

to be problematic. The comments did, however, all seem to focus on data capture/conversion issues.

Five of the ten respondents used contracting for conversion services. One reported doing only the packaging and shipping in-house. Three reported doing the data capture and conversion processes in-house and contracting the remaining services. The Howard County Library project did not produce a CD-ROM product, but used products commercially available. Most recommended the use of contractor expertise as the key issue here and highly recommended paying for that service.

The issue of standards and their importance received "Crucial" ratings from three of the ten project managers. Five of the project managers rated standards to be "Very Important." Standards were not considered to be important in the project at the Naval Research Laboratory Library and the project managers from Mead Data Central felt strongly that the importance of standards depends on the environment. Mead's representatives felt internal consistency to be more important than adoption of industry standards.

Each of the project managers had a different recommendation about standards. The manager of Project A recommends that the military services focus on "coordinating" computer development and integration activities during CALS development. The spokesperson for Project B suggests that developing standards early can save a lot of time. Project

C's representatives reiterate that consistency is more important than standards. The Air Force's MALS project manager suggests that a common indexing specification about how information is placed on the disc will resolve many data format standards problems. While Projects E, F, and G report the current ISO 9660 standards to be satisfactory, the manager for Project E makes additional recommendations regarding CCITT Group 4 standards and compression boards in lieu of compression software for graphics applications. Project H's manager suggests emphasizing flexibility to ensure maximum use of existing hardware in future applications. This addresses the efficiency, effectiveness, and productivity issues pertinent to the Navy project. The manager for Project I strongly states, "Don't wait for them--make them." This may be easier to do for the WORM project in its current (early) stage of development than for CD-ROM projects. The Howard County Library's Info LAN manager recommends standardization of search strategies and suggests that data format standards would increase usage. Since this project uses commercially developed products from various vendors in various data formats, the search and retrieval software and user commands which are directly related to the data format are necessarily different. This constrains the databases considered to those that are compatible with the current retrieval software known by the library's users.

The responses about quality problems were so varied it is recommended that Appendix F be reviewed for the best insight into quality issues. Four respondents indicated no problems in this area. Two reported problems with the search and retrieval software or the indexes. Two reported problems with the quality of the products being scanned, which increased subsequent quality problems. One subject indicated that non-specific standards resulted in "judgment" calls which translated into quality issues (consistency problems). Those organizations purchasing commercial products occasionally received "bad" discs resulting in a number of manhours lost to isolate the problem.

To successfully create a CD-ROM product, the majority report the most important considerations to be identifying the user and planning the data formatting to meet the users' needs.

Five of the ten respondents use the U.S. Mail as their current distribution means. Two did not distribute their products. One employed express mail services, another courier pouch services, and the Navy single prototype (paperless ship project) hand carries their product for security reasons. None of the subjects reported that their distribution means would change as a result of their projects, except to say that it would cost less.

Six of the projects are not involved in networking and of these, half do not plan to network. Of the four remain-

ing projects, one is currently networking, one has tested networking and determined it not to be useful for their purposes, and two are in various stages of development. In identifying limiting factors, lack of standardization in data format, software retrieval, networking software, and communications protocols were noted. The Howard County Library (the project that is currently networking) reports that the amount of memory required to handle the various devices and software programs limits the number of applications they can run on their network.

In describing the amount of experience their users have with computer searching, the responses range from extensive to none. Sixty percent reported "Some" to "None." A similar question regarding experience with communications protocols resulted in 60 percent reported as having "Some", "Little", or "None."

The extent to which users require training emphasized that the projects are relying heavily on the retrieval software and the overall system design to be self-teaching. The majority identified an intent to provide initial training to all users.

Three of the projects update their CD-ROM data quarterly, one updates semiannually, two update annually, and one updates according to the publisher's schedule (Howard County Library) Of the remaining three, two are currently WORM projects (one will employ CD-ROM for mass implementa-

tion) and do not require updating and the third is exploratory in nature and discs are not updated on a set schedule.

In their evaluation of what determined whether computers were justified for a particular use, three of the ten subjects identified the volume of information to be searched as key. Two of the respondents surveyed their users or used market research to suggest the need for computer hardware for a particular use. The need for portability was identified by one. Another relied on the advice of specialists. One subject simply referred to a general knowledge that computers are faster and more efficient.

The respondents identified networking to be more appropriate for uses where resource (specifically large database information) sharing among multiple users at various locations was necessary. A few of the respondents identified knowing what the user needs as the determining factor. The critical nature of the information and inability to rely on communications structure were reasons cited for not networking. Sensitive information was not perceived to be conducive to networking.

In response to the question about unique aspects of CD-ROM that would impact its success in "most" organizations, the answers were varied. Four of tne ten subjects described CD-ROM as easy to use, but expressed concern about the process of data conversion. Arthur Andersen &

Company's representative stated, "The criteria for CD-ROM was the key difference--knowing the limiting components of the technology and knowing whether your particular need applies."

The criteria for selecting hardware ranged from strictly competitive in terms of best price and features to the need for special equipment and the identification of a supplier or someone willing to custom build the equipment. Sixty percent report being "happy" with the hardware selected. Twenty percent stated they were not "happy" with the performance of the selected hardware. Project H's manager displayed dissatisfaction in being restricted to the slow Zenith Z-248 computers currently available to the Navy. Project J's manager related frequent problems with the multidisc drives and the result that a "downed" unit would take four databases with it.

The various recommendations about hardware should be reviewed in their entirety in Appendix F (See item 34.).

The criteria for selecting the software depended on the particular need of the project. Some were able to purchase off-the-shelf and others had custom built software to meet their users' particular needs. Features, ease of use, search capability, and availability were all deemed important.

Sixty percent of the respondents identified their software format standard to be "ISO 9660." Twenty percent stated they did not know what standard their software followed, ten percent followed the initial standard known as "High Sierra", and for the remaining 10 percent (WORM project) this did not apply. Sixty percent of the respondents reported being "happy" with the software selected while twenty percent were not. Project D's manager related that he did not know enough to ask for certain features and the developer's inexperience compounded his limitation. The manager for Project I reports that their software still has "bugs" and is not compatible with a lot of the products they would like to buy.

With respect to selecting software, the subjects were asked, "Knowing what you do now, is there anything you would do differently?" 70 percent of the respondents stated "No." Two responded "Yes" with one stating they would combine software that was available "off-the-shelf" and custom built software and would insist on being able to use a Boolean search within a sentence. The other "Yes" response indicated they would pay for an experienced company.

Success. The self-evaluation of success in meeting project goals and objectives understandably had varied responses. Project A, the "paperless ship" project, states that they have met all goals/objectives except "automating processing and modernization." Project B, the accounting

reference manuals project, reports they have gone beyond the original goals set. Mead Data Central's poisons and poison control procedures replaced microfiche and improved retrieval, but the goal to decrease publication time has not been completely realized. The Air Force's exploration into CD-ROM technology with the acquisition community has gone beyond their intended goals/objectives. The U.S. Army Corps of Engineers has gone beyond its expectations for decreasing costs. The Air Force Legal Services has not implemented their project. The Coca-Cola Company feels they have surpassed expectations in successfully demonstrating their ability to provide electronic policies and procedures to the company. The interactive technical manuals project is still in development. The Naval Research Laboratory Library's WORM project (approximately 10 percent complete) reports that space savings are being realized, but that the improved retrieval has not been met at all. Info LAN reports results beyond expectations.

Measuring system performance for the majority (80 percent of the respondents) was a matter of "Customer Satisfaction." Project B, the Arthur Andersen & Company project reported using all the mentioned performance measures in addition to measuring their client's improved services as a result of their increased effectiveness. A review of item 40 in Appendix F will provide a more complete perspective on the range of performance measures

Self-Evaluation. Often the success of a project is viewed in terms of senior management perceptions or those of the users. Eighty percent of the subjects reported that their boss is very satisfied with the project overall. One respondent reported the project was "beneath the boss's level of interest." A variety of responses were received concerning what influences the boss's perception (See Appendix F, item 42). Customer/user satisfaction were repeatedly noted as were improved services and increased revenues.

Sixty percent of the projects described their users as very satisfied with the project while 20 percent reported them to be satisfied. (Projects that have not yet been sufficiently available to the users were listed as "Not Applicable.") Forty percent of the respondents perceived that their users view "Accuracy and Quality" to be crucial. Six of the ten respondents commented that their users held ease of use to be very important or crucial to the new project. Six of the ten reported their users' perceptions were primarily influenced by ease of use, access, and maintenance. Another reported the effectiveness of the individual searches to be the key to the users' perceptions of success.

Seventy percent of the project managers report themselves as being very satisfied with the project overall. Only Project H's manager reported being dissatisfied with

the project. In reviewing his responses, it is apparent that the lack of senior management support combined with the standards problems may have led to his dissatisfaction. However, it is very early in the project and he had also mentioned being disappointed that things were not moving along as fast as he would have liked. Each manager held a different perception as to what was most critical to the success of a project such as this. Appendix F, item 46 identifies the responses to include identifying the users' needs, planning, management support, and the conversion of data.

Review. Item 48 was designed to take all the factors that were rated previously in the questionnaire as individual issues and have the respondents consider their importance relative to each other. Because there is no existing list of "Essential Factors for Success" this was an attempt to create and prioritize such a list. (This question was added after the interview with the project manager for the "paperless ship" project and follow-up solicitation for his response has been unsuccessful.) Table 4 is a summary of the respondents' evaluation of "factors important to the development and implementation of an 'electronic library'."

The descriptions of unexpected events identified by the project managers relate some information that is confirmed by other studies. Problems with installation of

Table 5

Respondents' Evaluation of Important Factors

Rank	Factor	Total Score	Mean	Variance
1	Planning	85	9.444	.778
	Identification of User Needs	85	9.444	.778
2	Clear and Specific Objectives	84.5	9.389	.736
3	System Performance	80	8.889	1.86
4	Developer Competence	77	8.556	3.028
5	Management Support	76.9	8.544	3.493
6	Hardware Interface Standards	74	8.222	5.194
7	User Involvement	64	7.111	8.364
8	Data Compression Standards	62	6.889	9.61
9	Data Format Standards	60	6.667	9.499
10	Internal Organization Stds	56	6.222	15.944
11	Impact of Organizational	54	6.0	10.751
12	Retrieval Software Standards	46	5.111	8.111
13	Perceived Risk (CALS)	37	4.111	4.112

hardware, software, and files are reiterated by Thomas Lahr and Dennis O'Conner in their August 1989 report "An Evaluation of DTIC's Prototype CD-ROM." (Lahr and O'Conner, 1989: 7-8). Netbios (network basic input/output system) and memory issues are confirmed by Howard McQueen in articles for CD-ROM EndUser and First Lieutenant Daniel J. Shagena

in his report on tests of networking options to implement the CD-ROM version of the FEDLOG database (McQueen, 1990a: 92) (McQueen, 1990b: 35) (Shagena, 1990: Section 10.0). The issue of what the products can do and what vendors will convince you they can do (real software versus "vaporware" or "dreamware") is one reason this research used project managers as subjects instead of vendors. Underestimating the bureaucracy and time to get a contract in place was listed as a "lesson learned". The need to budget for software licensing was overlooked on one project and set implementation back six months. See item 49 in Appendix F for the complete listing.

In reviewing the entire project, four of the ten respondents stated they would not do anything different knowing what they do now. Two commented they would have started earlier, but both perceive that as having been impossible considering the situations at the time. One stated a desire to have set firm standards up front after the determination of what the users' needs were. Still another added the need to know more about the technology beforehand. Other responses included identifying who the information is important to and obtaining funding.

The responses concerning what can be done ahead of time deal with identifying or defining needs, getting informed, planning, talking to unbiased users, and convinc-

ing the right people the program is right. For more information see item 51 in Appendix F.

Case Analysis.

Each manager had a unique response to the case analysis. The problems to anticipate included conversion and scanning issues of how best to "tag" the information. One subject suggested that online access seemed more appropriate than CD-ROM. Another subject believed that allowing the end user to make some decisions about the architecture might be dangerous. (This response related to information the subject had received directly from the Air Force project manager, rather than that provided by the researcher.) Other responses indicated that the user must be more clearly confined and defined, quarterly updates seem too frequent, avoid becoming too equipment dependent, awareness of "cultural change" and "resistance to change", and planning appropriately to deal with the issues. Given the length of the interviews, it was not surprising that the case analysis often prompted more questions than it answered. The respondents were very sincere in their desire to assist and many offered their professional services should the Air Force intend to pursue this project. A review of the Case Analysis responses is necessary to obtain an understanding of the varied results that are a result of the different program experiences.

Summary

The ten project managers interviewed provided the information based on experience which is lacking in the current literature. A ranking of "Important Factors" was obtained based on the responses to item number 48. The responses place planning, identification of user needs, and clear and specific objectives at the top of the list. The least important factor according to the respondents was perceived risk. Based on the information gathered from the interviews and the information provided by the literature review, the research will proceed with conclusions and recommendations in Chapter 5.

V. Conclusions and Recommendations

Overview

The advances made in computing technology in recent years have led to what many have called an "information revolution." The volumes of information being created have reached unmanageable proportions. Library repositories are growing so rapidly that a means of sifting through the massive amounts of information to locate what is relevant has become quite a challenge. For those who have recognized the increased value of information and applied their resources accordingly, the rewards have been many. Others have waited until they have encountered problems in their ability to manage the information.

This research explored the literature and interviewed those with experience in employing new technologies in adjusting their information systems to meet today's information demands. One such proposal has been "electronic libraries." The goal of the research was to eliminate some of the risk associated with new technologies through a better understanding of the experiences of past and preser "electronic libraries" program managers. The first research objective sought to answer the question, "What factors are essential to the successful development and implementation of electronic libraries?" This will be primarily addressed in the conclusions below. A second objective was to take the experienced users' information

with respect to CD-ROM development and implementation issues and make recommendations to the Air Force advising of problems which might be encountered and how to avoid them in their pursuit of the IM Net proposal. The conclusions and recommendations of this chapter are based upon the information obtained as a result of telephone interviews with program managers. Finally, the researcher identifies current research at the Air Force Institute of Technology on related topics and recommends more extensive research to validate the "essential success factors" resulting from this exploratory study.

Research Conclusions

Computer searching is a key consideration. The basic goals of the subjects interviewed were twofold. The first goal was a the desire to improve effectiveness. This was evident not only in the descriptions given for the goals/objectives of their projects, but also in their identification of what was considered important in the initial considerations for their projects. While not in complete agreement, seven of the ten respondents identified the need for "computer searching" to be essential, presumably as a means of improving effectiveness. The second goal was to improve efficiency. Again, this was evident not only in their descriptions of the project's specific goals, but also in the importance placed on "immediate availability of supporting equipment", "data already in convertible form", "frequency of updates", and "wide distribution capability."

The use of contracting for services in CD-ROM production is prevalent. Eight of the ten projects selected CD-ROM as the media by which to best meet these goals. Of these, five have or are planning to produce their own CD-ROM product. All the projects producing CD-ROM products contracted for the pre-mastering and mastering services and all but one contracted for the data preparation services. While some have since ventured into in-house pre-mastering, the majority indicated they would still recommend reliance on contractors. The primary reason given was that the advantage gained by using contractor experience and equipment far exceeds the cost savings obtained by doing pre-mastering and mastering in-house.

Planning and identifying users' needs are extremely important, but user involvement is not always necessary. As previous research has suggested, all subjects were in relative agreement about the importance of planning, but no consensus about the optimal plan was obtained (Smith, 1987: 26-7). Planning and identification of users' needs were identified by the majority as being crucial to a successful project. It is noteworthy that while six of the nine respondents rated identification of user's needs as crucial (rating it a 10), only two held user involvement to be crucial. This may suggest that the respondents believe there are other means of identifying user needs without direct user involvement. Again, this supports information from previous research in this area (Smith, 1987: 26-7).

Respondents disclosed the predominant use of prototyping in development and implementation. Seven of the ten projects employed prototyping as the means to develop and implement the project. The literature suggested that "prototyping is used when requirements are difficult to specify in advance or when requirements may change significantly during development" (Davis and Olson, 1985:569). None of the interviewees indicated any such difficulties with requirements. On the other hand, the subjects did appear focused on resource efficiency which is one of the advantages of the prototyping approach described in Chapter 2. It is also important to realize that the planning process for the prototypes still followed the life cycle approach which the literature suggested to be the most common (Chapter 2, Development Using the Life Cycle Approach). This research appears to indicate that current program managers find a "combined" approach more desirable.

Risk was not perceived as much of a player in project development and implementation. It is striking that half of the respondents identified the perception of the risk to be high (single factor rating), but for various reasons. While inexperienced with the technology, most viewed it as low in complexity. In evaluating perceived risk with respect to all factors discussed, the respondents generally agreed (standard deviation of .882) on its low level of importance.

Management support ranks fifth overall among importance factors. The individual ratings of the importance of management support included six "Crucial" votes and four "Very Important" votes. However, relative to all the factors considered, it ranked only sixth with four "Crucial" votes and one slightly less than "Crucial" (9.9 rating). One subject rated it at five, indicating it to be of "Moderate" importance.

Changing the organization was not expected. Five of the ten respondents indicated the new technology was not expected to change the overall organization. Many simply felt it was a cheaper, more effective way of doing what they had always done. While acknowledging that most of their users ranged in experience with computers from "Little" to "Some", there were high expectations with regard to the ability of the system design to convert the users.

Subjects related general agreement with regard to developer competence. Developer competence as an independent factor received six "Crucial" and four "Very Important" votes, but relative to the other factors held only the fourth position overall. The researcher attempted to have the interviewees differentiate organizational responsibilities (Defining and Identifying Objectives) from developer responsibilities. However, it was apparent that many subjects believed the developer was responsible for

everything from defining and identifying objectives to providing technical, documentation, and training support.

Interviewees viewed the data conversion process as the most "laborious" part of CD-ROM development. The CD-ROM development questions confirmed previous literature reports that the data conversion process is the most "laborious and time consuming." Many of the subjects identified that setting standards early would have eased this process. The prevalent issues here were data format standards and knowing enough about what the users' needs are to facilitate proper data formatting and effective software retrieval design. Although deemed important, there were very mixed recommendations about how to resolve standards issues.

The study affirms that few organizations are networking with CD-ROM. One of the more surprising issues emerging from the research has been the lack of networking with CD-ROM. The literature would lead one to conclude that networking is widely used as a means of sharing resources. However, the subjects interviewed indicated that network operating software is only beginning to be able to handle the demands of CD-ROM. As indicated by the responses of the spokesperson for the Howard County Library, two years ago the publishers "were in shock when I asked if we could network their products." Many of the issues dealing with networking are yet to be addressed. The Coca-Cola Company observed that their network proved to be too slow and the

users did not really need to share the information. Consequently, the networking has been eliminated from their project except as a backup in certain critical places.

Many believe quarterly updates of CD-ROMs are too frequent. The frequency of updates seems to depend on two things: how often the information changes and how critical the changes are. The majority of the respondents felt that quarterly updates were too frequent for their operations considering the cost of mastering. All were contemplating using floppy disks to make interim changes and most anticipated loading the changes onto the hard drives of their systems to permit access by the search and retrieval software so that the changes would be invisible to the user.

Multiple CD-ROM drives were revealed to be problematic. The hardware problem the Howard County Library experienced with the multiple drive units (sensitivity to dirt which caused drive unit to go down) was a valuable piece of information. It suggests that the Air Force, should it pursue IM Net, might wish to rethink this issue or ensure adequate system availability is a prime consideration in their acquisition process.

Search and retrieval software and indexing are viewed as critical elements of electronic libraries. The search and retrieval software and indexing appear to be critical elements of improving effectiveness. Most of the respondents recommend using an experienced developer as opposed

tc developing in-house. They suggest dealing with a reputable vendor and doing the necessary quality checks to ensure the accuracy of the information and thus user satisfaction. Many expressed the need for a "partner-like" relationship between organization and developer or contracting agency and contractor (Kercheval, Gries, Orner, Schankin, and Hill).

Interviewees identified reduced costs to be a major objective that is relatively measurable. Confirming what was revealed in the research conducted by Captain Wilburn W.L. Smith, no factor was found to be the sole determinant of success (Smith, 1987:26-7). Most goals/objectives focused on hard or measurable attributes such as reducing the costs of storage and distribution. Some attributes are less measurable in nature, but also contribute to the success of the system. Measuring the value of information and its effectiveness is difficult and is primarily based on subjective assessments. While the managers for Projects B and G would argue that the results in dollars and cents can be identified and attributed to their system, not one of the respondents could identify how they measured effectiveness or efficiency. Customer/User Satisfaction was the most agreed upon measure of system performance.

Project managers expressed general satisfaction with their projects. Almost everyone seemed satisfied with their projects. The exception was the Navy "interactive

technical manuals" project, but it is just getting started. Much of their current dissatisfaction seemed to stem from "fighting the pace of a bureaucracy" in achieving the implementation of their system.

Seven Essential Success Factors. The interviewees' responses to item 48 of the interview questionnaire provide a convenient summary response to the first research question. (Since one of the respondents was unable to provide input for this question, the responses represent only nine of the ten interviewees.) Collectively, the subjects provided the following seven factors as most "important to the successful development and implementation of an 'electronic library'."

1. Planning (Mean: 9.44)
2. Identification of User Needs (Mean: 9.44)
3. Clear and Specific Goals/Objectives (Mean: 9.39)
4. System Performance (Mean: 8.89)
5. Developer Competence (Mean: 8.56)
6. Management Support (Mean: 8.54)
7. Hardware Interface Standards (Mean: 8.22)

The next ranking factor (User Involvement) had a mean score more than one point lower than that of the factor above it: the greatest break observed between mean scores.

Recommendations

The success of a project designed to change or modify the current information system must provide a valuable

service to its users. Consequently, the researcher recommends that the Air Force carefully describe its user population and ascertain what constitutes valuable service to those users. This task may not be easy given the size and diversity of the population. In response to the case analysis, some of the respondents recommended that a "focused user group" be found. A focused user group may be described as a segment of the user population that has a clear and definite need for which a rapid prototype can be developed, tested, and evolved into a full scale project. Mead Data Central commented that of the four or five CD-ROM projects that have been started, the successful ones have had "clear and specific objectives" and the unsuccessful ones did not have focus.

The subjects' concerns regarding standards, hardware, and software should be closely considered in the development plans for future Air Force projects in this area. Specific examples discussed previously include problems with multiple drive units and the importance of the retrieval software and indexes. For Air Force applications, it may be particularly important to remain actively involved in the evolution of CALS standards.

The various subjects appeared to have experience particularly relevant to the Air Force project. The corps of engineers project dealt with the printing, storing, and distribution of government documents and represents expe-

rience operating within some of the same constraints the Air Force is subject to. The Coca-Cola Company experienced some of the cultural ramifications of worldwide implementation which the Air Force might expect to encounter. The Navy projects are focusing on the technical manuals deemed important not only to the maintainers, but ultimately to the mission and represent a potential future application for the Air Force beyond IM Net.

Conclusion

Relevant research is in progress at the Air Force Institute of Technology. One related study which provides new information pertinent to this research is "The Use of Hypertext for the Development of An Office Reference System on Economic Analysis" by Captain DeAnna L. McMurry (McMurry, 1990). Using hypertext software for personal computers, Captain McMurry developed a test project for cost and acquisition regulations and conducted an experiment with graduate students at the Air Force Institute of Technology to assess its ease of use and value. In essence, Captain McMurry tested on a small scale what the Air Force would like to do on a large scale with project IM Net. The study also provides a potential "focus group." Another potential focus group is identified in "A Telecommunications Approach to Updating Technical Orders" by Captain Charles Fox (Fox, 1990).

The issue of training is pursued in "A Study of the Air Force's Current Method of Training Individuals to Use Contractor Developed Software in Information Management and the Perceived Effectiveness of the Training" by Captain Bruce Harmon (Harmon, 1990). The training issues and concerns were addressed by Weiskel in Chapter 2 and re-emphasized by the respondents in that lack of experience with computers required a great deal of "user friendliness" be built into the systems. As Captain Harmon's study reveals, there are many shortcomings in the way the Air Force trains individuals in information management. "Air Force Information Management (IM): A 1990 Snapshot and 1995 Future Look at AF IM Needs and Preferred Educational/Training Approaches" by Captain Richard T. McGhee indicates that Information Resource Management graduates from the Air Force Institute of Technology expressed as one of their top concerns a lack of knowledge about CD-ROM technology (McGhee, 1990).

This research identifies seven "essential success factors for electronic libraries" but these are only initial factors requiring further validation. It is therefore recommended that more extensive research be conducted to establish the reliability of these factors and to verify their generalizability.

Appendix A: Point Paper Describing SON #011-89

POINT PAPER

ON

IM NET PROGRAM STATUS

BACKGROUND:

Information Management Network (IM Net) is a program to modernize how the Air Force disseminates Air Force policy and provides Air Force forms by capturing most publications and many forms in an electronic media and making them available to users with modern office automation equipment. (Note: Classified publications, test materials, many forms, visual aids, etc. are excluded.)

- Atch 1 shows the information flow with and without IM Net.

- Atch 2 shows the IM Net Architecture. Under the Air Force's open architecture concepts, IM Net will operate in many different hardware configurations. These include, but are not limited to:

  -- A multiuser host in IM connected to the base's local information transfer architecture (LITA) system (could be a base wide LAN, a BIDDS switch, etc.). The multiuser would have access to CD-ROM drives containing the libraries of publications and forms. Customers could connect to the host, over the LITA, from workstations in their work area.

  -- A single user file server in IM connected as above. Difference here is that only one person at a time could access the libraries, however the hardware would be cheaper and easier to administer.

  -- Multiple standalone PCs with a CD-ROM drive on each PC.

STATUS:

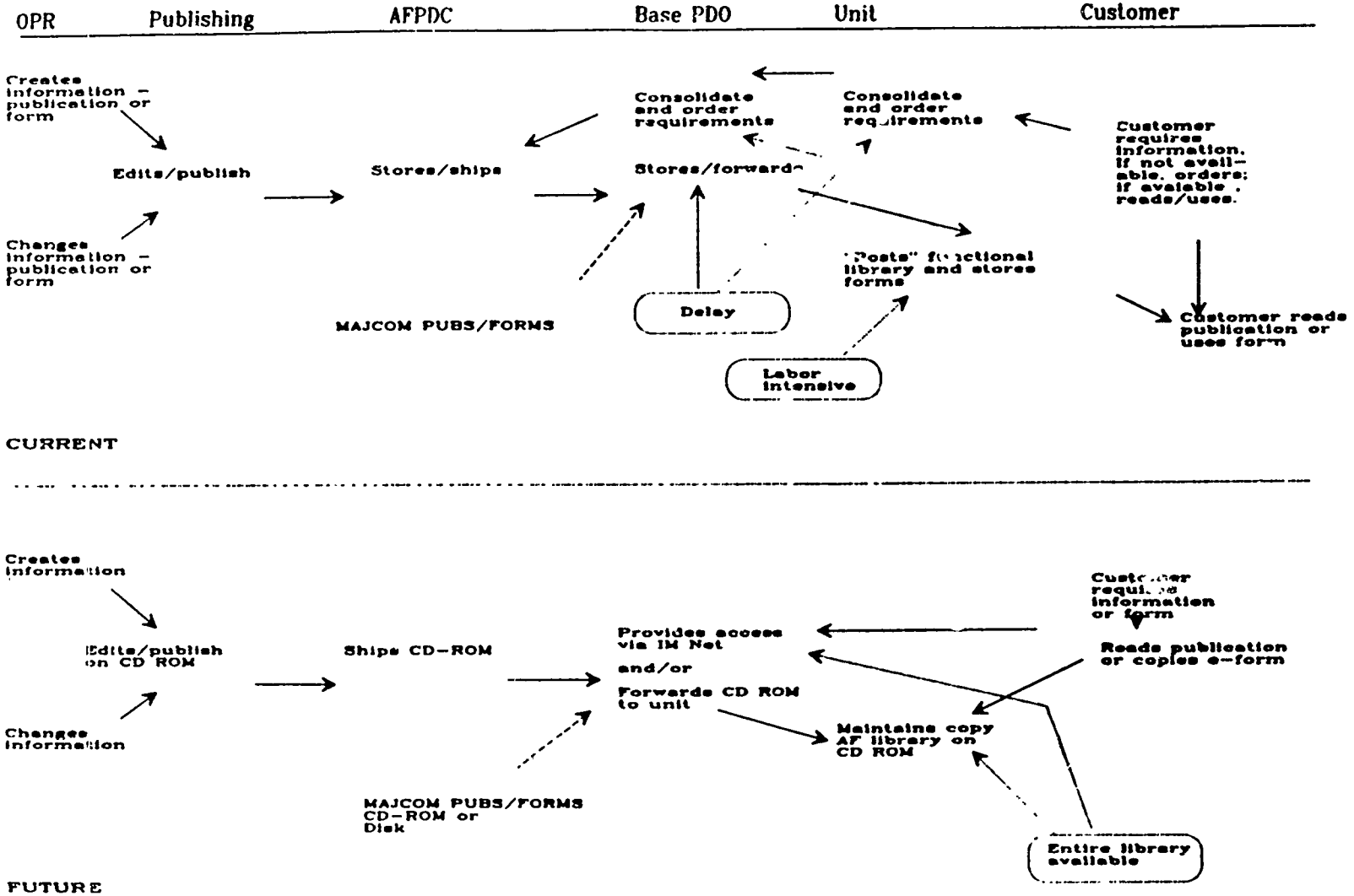
- The Air Force Communications-Computer Requirements Board Working Group approved the Statement of Operational Need (SON) for IM Net (#011-89) on 26 Jan 90.

- SAF/AAI submitted an FY92 funding initiative for IM Net to the C-CS Panel. After reviewing it, the Panel, combined it with a DMR initiative which called for using CD-ROM to distri-bute Air Force regulations and forms. SAF/AAI conducted a study to evaluate potential benefits and projected costs and submitted it back to the C-CS Panel where it is still pending a decision on funding (see atch 3).

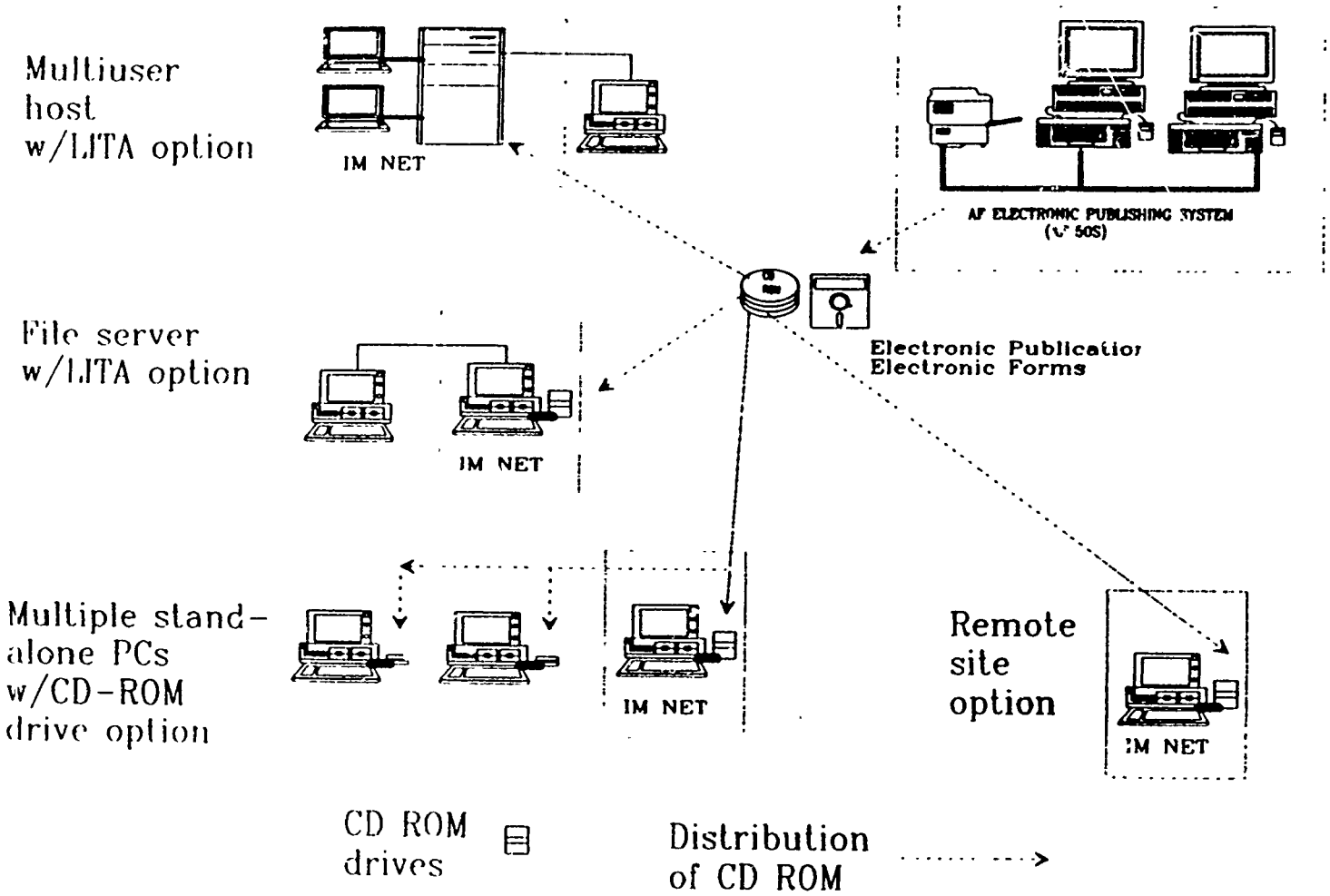
3 Atch
1. Information Flow
2. Architecture
3. IM Net CD ROM Initiative

Lt Col Daviess, SAF/AA A, 4-0657, 19 Mar 90

INFORMATION FLOW



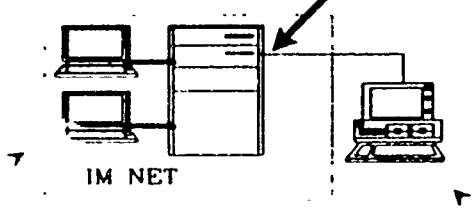
IM NET ARCHITECTURE



Multiuser host w/LITA option

Features
- AT&T 3B2 with CD ROM drives as host
  Customers connect to 3B2 host via
  any standard LITA option

Electronic Publications
Electronic Forms



AF Electronic Library from AFPDC
MAJCOM Electronic Library from CPDC
Base Library from Base IM

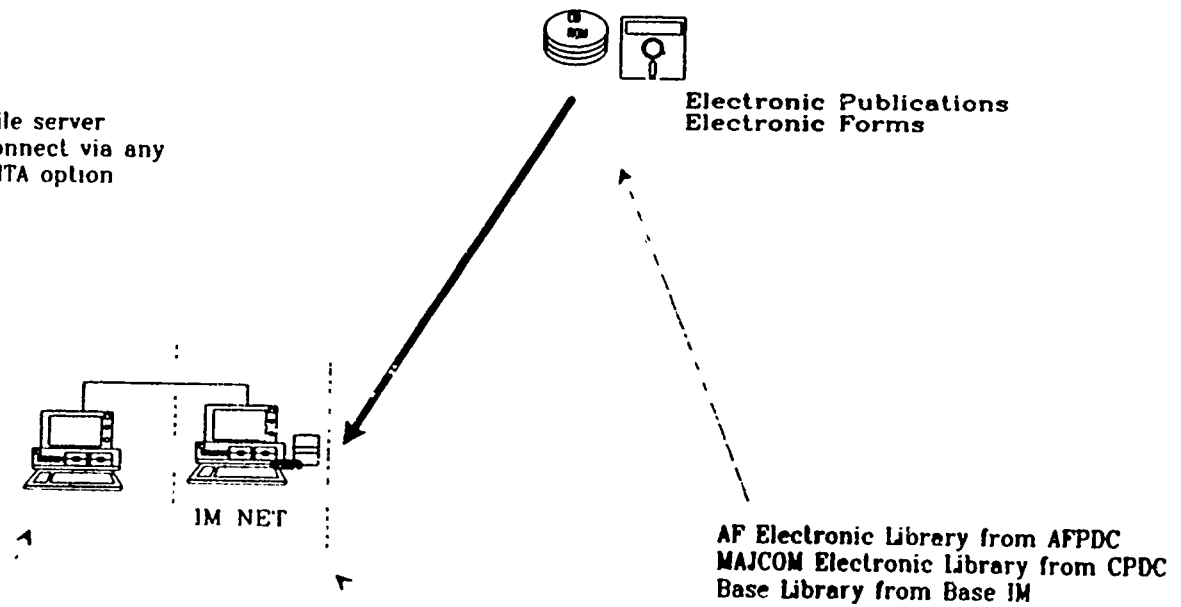
Terminals within IM

AT&T 3B2

Remote computers/terminals
connected via Local Information
Transfer Architecture systems

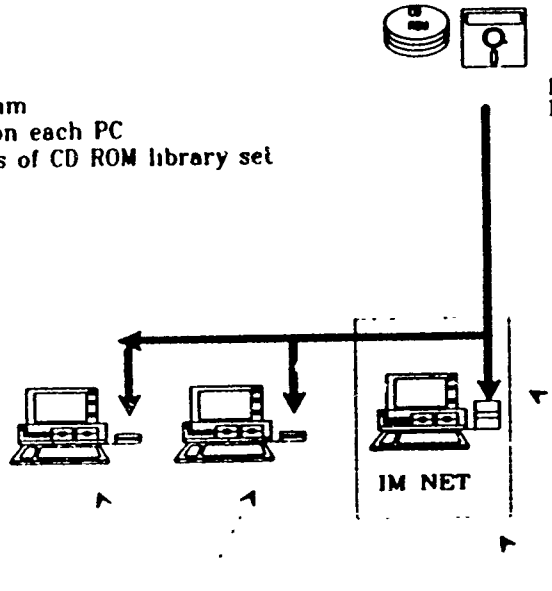
File server w/LITA option

Features
- Single user file server
- Customers connect via any standard LITA option



Multiple stand-alone PCs w/CD-ROM drive option

Features
- Does not require comm
- Uses CD ROM drives on each PC
- Requires many copies of CD ROM library set



Electronic Publications
Electronic Forms

AF Electronic Library from AFPDC
MAJCOM Electronic Library from CPDC
Base Library from Base IM

Remote computers with CD ROM drives and copies of AF and MAJCOM Libraries

PC with CD ROM drives

PDO distributes copies of CD ROMs to functional libraries

POSITION PAPER

ON

IM NET CD ROM INITIATIVE

The H Panel requested SAF/AAI study a DMR initiative to place all Air Force publications and forms on CD ROM. This initiative dovetails closely with two programs in SAF/AAI--IM Net and Electronic Publishing. We evaluated the potential benefits and the projected costs of converting the library of Air Force publications and forms to CD ROM and putting in place the equipment needed to let our customers access the library.

The benefits include (see attachment 1):

- Hard dollars. Reduced printing and distribution costs at AFPDC and some MAJCOM PDCs.

  -- Our analysis of the printing and distribution costs at SAF/AAIP and AFPDC-level after FOC shows a projected annual savings of $5.1M.

- Soft dollars. Reduced costs of warehousing at every base PDO and manhour savings in every Air Force office which uses Air Force regulations and/or forms as well as, improved availability of information.

  -- Our analysis of the potential "soft" dollar savings assumes a very conservative one hour a month saved in each of 48,000 offices in the Air Force--which results in an annual savings of $9.4M.

  -- Our analysis of the current system to distribute information also shows that there is a potential for serious delays in obtaining information (while the required regulation is "backordered") and a very labor intensive process to keep regulations updated ("posted") in every office in the Air Force--commanders could be forced to make decisions without the correct information. The future system provides access to the entire library of publications. (See attachment 2).

The costs include:

- $ 5.3M one-time cost to convert the existing library of over 201,000 pages of publications and over 7,000 pages of forms into the format required by the Air Force Electronic Publishing Program (50S). An additional $.5M is required annually to reissue the CD ROM library every quarter and to maintain the software. The conversion costs include (see attachment 3):

  -- Actual digital conversion of text and graphics.

  -- Development of Air Force-owned indexing and search/retrieval software to use with the CD ROM.

Lt Col Daviess, SAF/AAIA, 4-0657, 16 Feb 90

- $ 36.9M to install equipment throughout the Air Force which will provide local Air Force personnel access to the electronic library plus $2.5M recurring annual life-cycle maintenance costs. The IM Net program identified these costs during the SON validation process (see attachment 4).

RECOMMENDATION:

Recommend this initiative be funded.

- If the Air Force recognizes a value to the "soft" dollar savings created in the thousands of Air Force offices, then the program pays back $11.5M per year after FOC.

- If the Air Force only recognizes the "hard" dollar savings then the program pays back approximately $2.1M per year after FOC.

5 Attachments
1. Cost/Benefits
2. Information Flow
3. Conversion Costs
4. IM Net SON
5. PDP Input

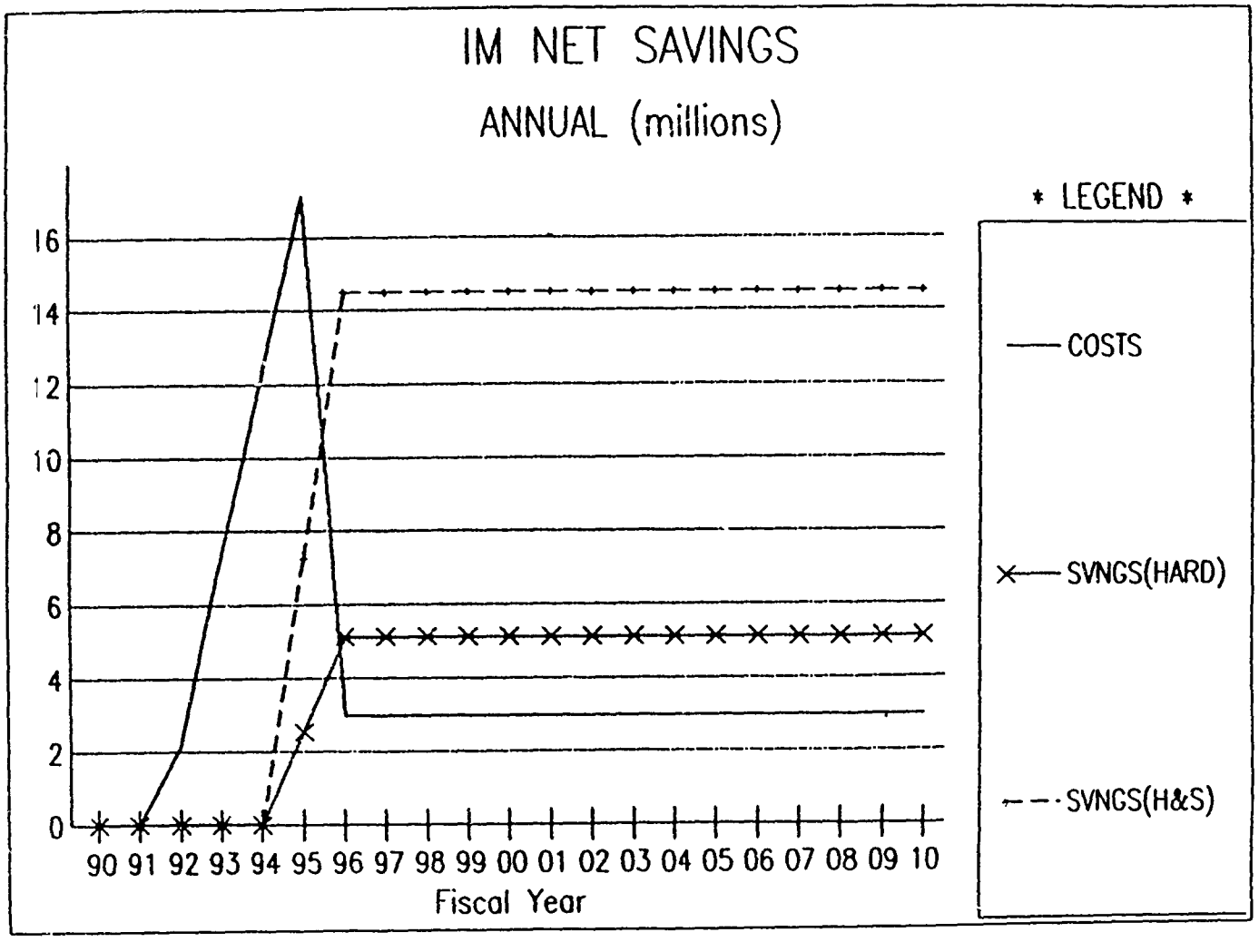
I M N E T

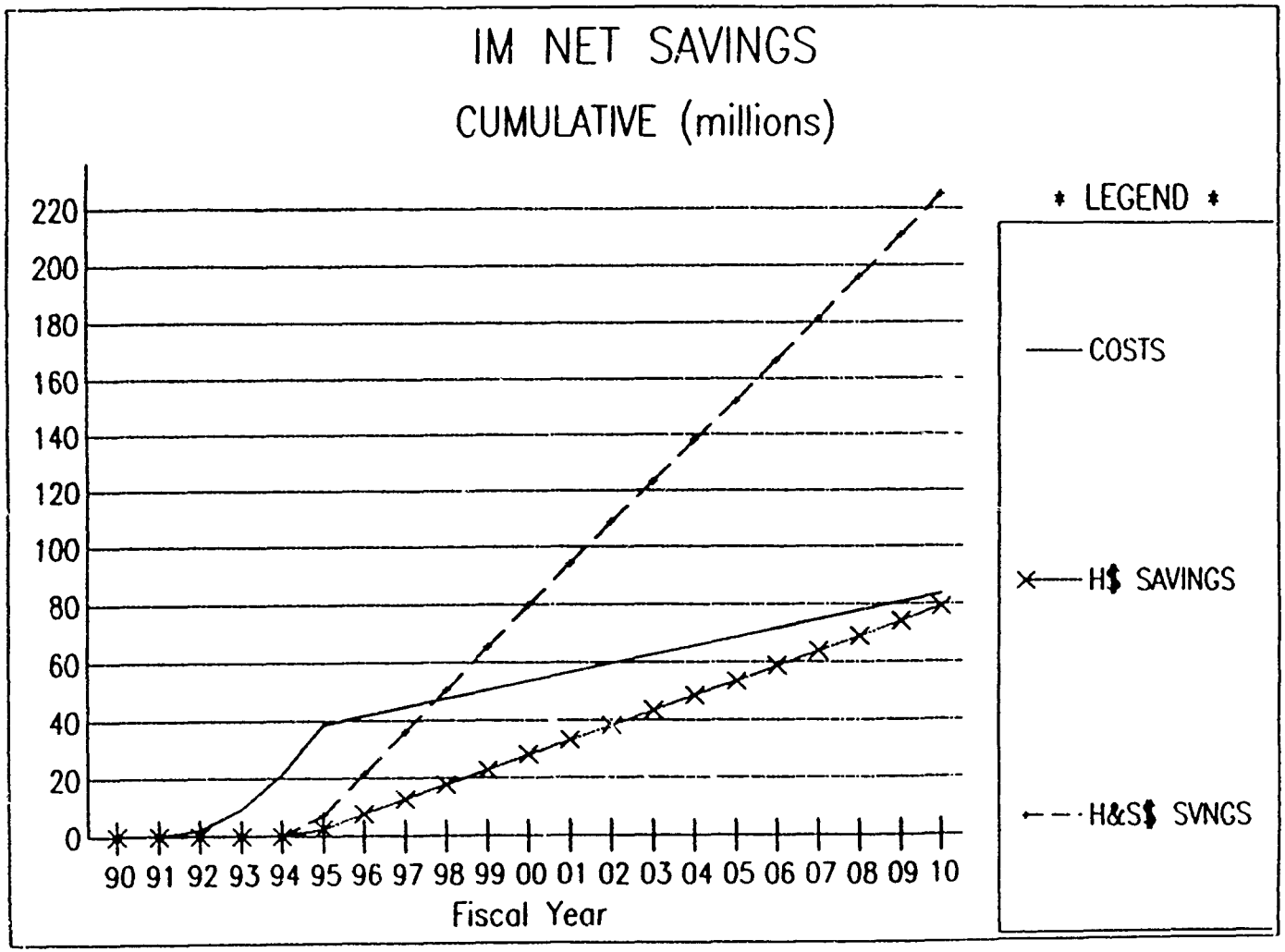
COSTS	BENEFITS	
	HARD $$	SOFT $$
	REDUCED PRINTING & DISTRIBUTION AT AFPDC	MANHOURS IN EVERY AF OFFICE
		REDUCED WAREHOUSING AT BASE PDOs.
200 SYSTEMS (AT&T 3B2) + CONVERSION		
$ 4 4.7 M*	$ 1 2.8 M**	$ 23.5 M***

* SIX YEAR COST

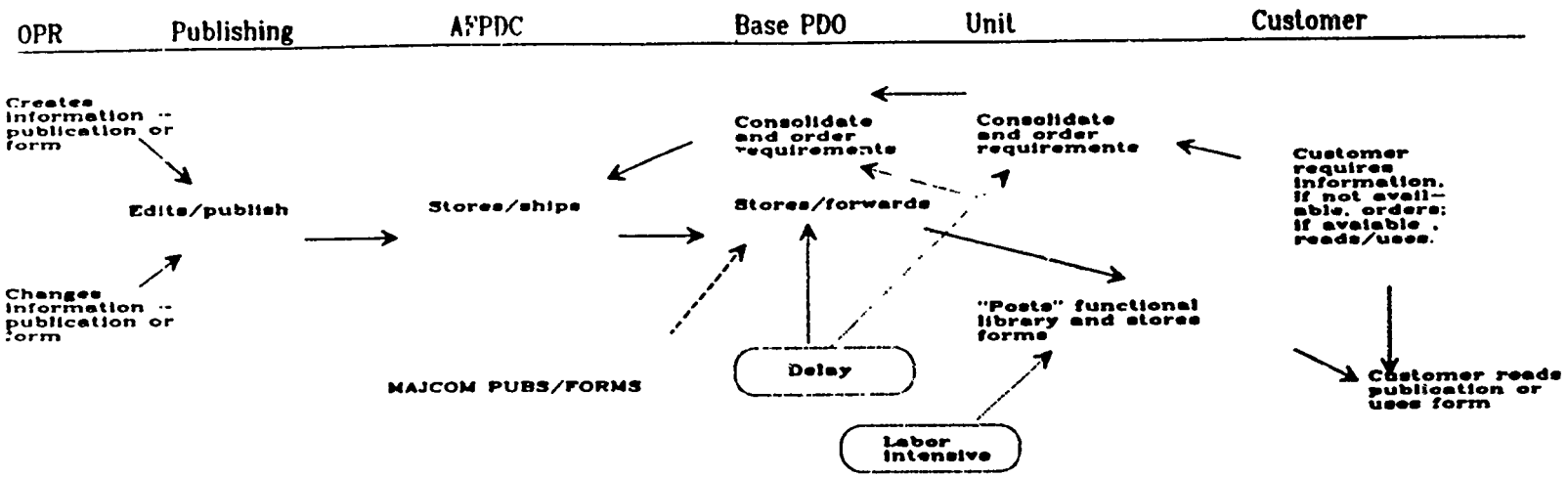
** TWO AND A HALF YEARS OF PAYBACK, PLUS $5.1M PER YEAR THEREAFTER.

*** DUE TO NOT HAVING TO POST REGULATIONS AND HAVING E-FORMS ON LINE, (e.g. SAVE ONE HOUR/MO IN 48,000 OFFICES = $9.4 M/YR X 2.5 = $23.5 M).

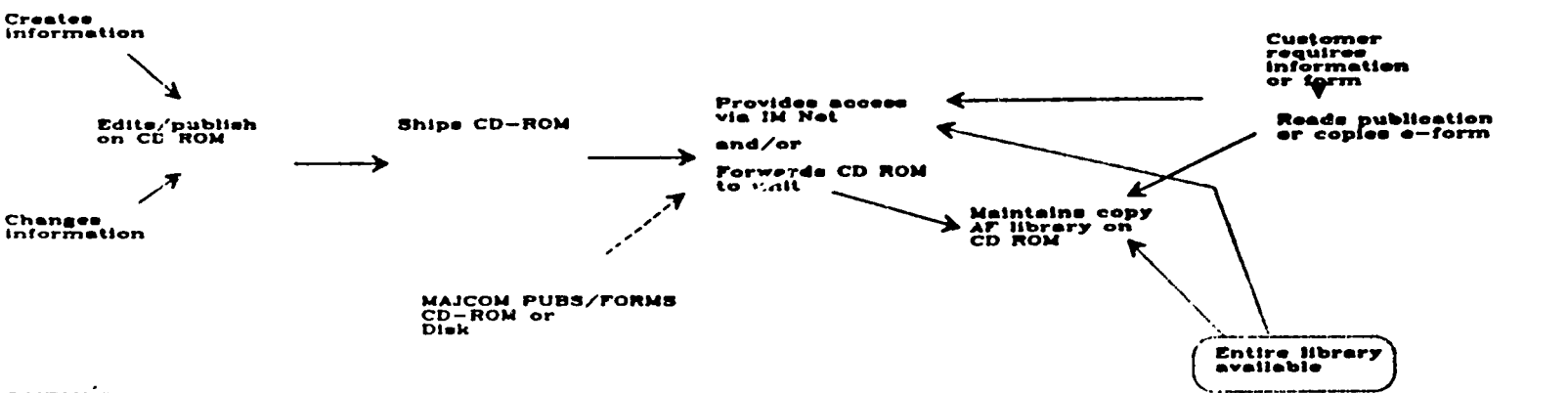

IM NET SAVINGS
ANNUAL (millions)
* LEGEND *
COSTS
SVNGS(HARD)
SVNGS(H&S)
16
14
12
10
8
6
4
2
0
90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10
Fiscal Year


IM NET SAVINGS
CUMULATIVE (millions)
220
200
180
160
140
120
100
80
60
40
20
0
90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10
Fiscal Year
* LEGEND *
COSTS
H$ SAVINGS
H&S$ SVNGS

INFORMATION FLOW



CURRENT



FUTURE

TOTAL COST/TIMING ESTIMATES FOR IM-NET PROJECT

as of 16 Feb 90

FY92		
Develop DTDs	$600,000	*6 months
Develop Standard Indexing Software Specifications	250,000	*6 months
Publications Conversion		
Text (40,896 pages)	274,000	9-12 months
Graphics (4,543 pages)	74,300	9-12 months
Total	348,300	
Electronic Forms Development		
EForms (1,757 pages)	439,250	9-12 months
Total	$1,637,550	
*Note: Can be developed concurrently		
FY93		
Develop Standard Indexing Software	$ 200,000	6 months
Develop Standard Search/ Retrieval Software	400,000	6 months
Develop Manuals	150,000	6 months
Publications Conversion		
Text (122,690 pages)	822,000	18 months
Graphics (13,625 pages)	222,800	18 months
Total	1,044,800	
Electronic Forms Development		
EForms (5,275 pages)	1,318,750	18 months
CD-ROM Production & Distribution (Initial Set)	513,000	3 months
Total	$3,626,550	
TOTAL FY 92-93 CONVERSION COSTS	**$5,264,100**	
FY93-97		
CD-ROM Production and Distribution (Four Quarterly Updates)		$ 380,000
Software Maintenance		$ 150,000
Annual Total		$ 530,000

SAF/AAI
LT COL DAVIESS
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AV 224-0657

SAF/AAI Statement of Operational Need (SON) #011-89 Information Management Network (IM Net) Software

1. Mission:

a. Mission Area. An operational mission need exists in the following mission areas (re OUSD(A) Mission Area Directory):

Primary Mission Area:	473	Base Operations
Second Mission Area:	474	Management Headquarters
Third Mission Area:	476	Training, Medical, and other General Personnel Activities.
Fourth Mission Area:	477	Administration and Associated Activities
Fifth Mission Area:	470	Management Support
Sixth Mission Area:	482	Management Reserves
Seventh Mission Area:	479	Service Support Activities

b. Mission Element Need.

(1) Mission readiness has been and continues to be impacted by Information Management's (IM) lack of capability to develop and implement policy to manage Air Force information, regardless of media, throughout its life cycle.

IM's current policies and infrastructure were established to manage Air Force information in a paper-based environment. Programs and policies like Publications and Forms Management, Records Management, and Administrative Communications policies were developed to manage the life cycle (creation, collection, reproduction, distribution, retention, and disposition) of information contained on paper. The proliferation of Automated Data Processing (ADP) equipment and Communications-Computer Systems (C-CS) resulted in a tremendous amount of information that is maintained digitally throughout its life cycle and never becomes paper-based. We must develop policies for digital information that address the same issues that our current policies do for paper-based information. This does not necessarily mean applying paper-based policies in an electronic environment. IM must consider the users' requirements and legal constraints and develop policies that will help users manage their information effectively. IM's current infrastructure doesn't support this requirement. The IM Net software will be one of the building blocks for the Air Force IM community to develop information management policy.

(2) Mission readiness has been and continues to be impacted by the inherent incapability of the current, mostly paper-based system to disseminate Air Force policy and provide Air Force forms, regardless of media, in an accurate and timely manner. This shortfall impacts Air Force commanders in two ways:

(a) **Distributing Air Force Policy:** Air Force disseminates policy and procedures via Air Force publications. The current Air Force publications system is labor intensive. The system relies on paper copies of regulations, printed at centralized locations, held in warehouses, shipped around the world, stored in "functional libraries" or "personal libraries" and updated via manual page changes. The effectiveness of this system depends upon the efforts of the local clerk, secretary, or action officer to keep the regulations posted with "page changes". Unfortunately, commanders, seeking accurate information, often find they do not have current and up-to-date copies of regulations. Even worse, commanders who need access to a regulation, not previously maintained, often find that it is "backordered". Many of these commanders have access to modern office automation tools--stand-alone PCs, multiuser, networked or shared resource systems. Their staffs use these same tools to create the original drafts of the publications and prepare them for production printing. SAF/AAI is creating and maintaining a database of up-to-date electronic copies of the regulations with a modern state-of-the art electronic publishing system (AF-SOS). These systems could provide commanders with immediate access to Air Force policy and regulations (including MAJCOM and base regulations and supplements) that they need. Information Management should distribute this electronic "library" to Base IM's and their customers--the unit commander. Each office with remote on line access to libraries of Air Force Publications would not only be able to read the latest policy but also save the man-hours involved with today's manual labor intensive publications library maintenance and research processes.

(b) **Using Air Force Forms:** Information is usually gathered and organized using forms. Whether preparing efficiency ratings, staff recommendations, or ordering supplies, commanders use forms to gather and manage information. New technologies affect this process:

[1] Commanders with access to modern linked office automation systems can send information from location to location via electronic mail--unless they must use a form. Yet forms are one of the primary means of gathering and organizing data. The Air Force needs the ability to send organized information in an electronic form from place to place.

[2] Our current paper forms are difficult to use with many printers, especially laser printers. Air Force personnel using word processors, office automation systems, and similar tools find that they spend hours trying to line up preprinted forms so information prints in the correct blocks. This wastes time and material. These people need electronic forms which match the image of the form with the data required on the form and print the results on bond paper.

c. Joint Service and Multinational Applicability. The Air Force communicates with and provides copies of Air Force publications and forms to other US and Allied military services as well as the public. This means that the Air Force must be involved in developing, coordinating, and complying with all applicable standards (Examples include GOSIP, POSIX, IEEE, ISO, etc.). In particular, IM Net must comply with current and developing standards because the IM mission includes moving Air Force information throughout the Air Force, DOD, and the government.

2. **Basis of Need.** The changing technologies in office automation and Information Management's critical need to support the commander's mission are the basis for this need.

a. In the paper and microform environment, the Air Force bases current policies, procedures, and systems for managing information on public policy and Public Laws which include the Federal Information Resources Management Regulation; Titles 5, 32, 39, and 44 of the United States Code; the Paperwork Reduction Act of 1980; the Goldwater-Nichols Department of Defense Reorganization Act of 1986; and the Paperwork Reduction Reauthorization Act of 1986. When only paper or microform media is managed, the speed of physical object (paper, microfiche, etc.) movement allowed and encouraged a paper-based tracking system. This is no longer true.

b. Recently, the rapid influx of automated systems - using computers to create and maintain larger quantities of more accurate information, move it faster, and reduce costs - has deeply affected and changed the way commanders accomplish the mission. Public Law reflects these changes by establishing guidance on the life cycle management of information, office systems management, reducing the paperwork burden on the public, confidentiality of individual personal information, providing public access to government maintained information, etc., "regardless of media." Air Force activities comply with these public policies and laws when installing personal computers, and networked, multiuser, or shared resource systems. In order to support the Commander, Information Managers must plan for and adapt to this new and changing environment.

3. **Assessment of Capability:**

a. **Existing Capability.** The current Air Force Electronic Publishing System (AF 50-S) provides Air Force and MAJCOM publishing officials (SAF/AAIP and MAJCOM/IMPs) the capability to use modern, state-of-the-art systems to publish electronically stored regulations and forms, but in paper copy. The Official Mail Program and the Base Information Transfer System (BITS) provide the capability to move paper only. The Publishing Distribution Office System (PDOS) electronically tracks the paper flow for publications and forms distribution and operates in stand-alone mode only. Publications library maintenance and access is a totally manual process. With no standardized exceptions, forms are paper-based and data transfer from the forms to electronic media is two-step; first fill out the form, then keystroke the data into a system. The entire rationale for the BITS is the movement of this (and other) paper from place to place.

b. **Planned and Programmed Capability.**

(1) The follow-on contract for the Air Force Electronic Publishing System (AF 50-S) will provide, in about two years, the capability to accept, edit, and publish Air Force and some MAJCOM regulations and forms on electronic media (most likely CD-ROM). However, this contract does not provide the capability to manage and/or read the electronic media at base or unit level. It automates publishing functions, but is too large and expensive to automate those same functions (and others) that exist below the large MAJCOM level.

(2) Computer systems and networks are being fielded by many organizations (PCIII, CAMS, CCPS, etc.). These systems, if physically connected together by networks and logically connected by Air Force policy, lay the ground work for official electronic mail (Defense Messaging System (DMS)). This same linked environment allows base/unit offices the capability to connect to the proposed IM Net publications/forms electronic library database.

(3) All base level IMs will operate in an automated environment. Word processing, spreadsheet, database, and telecommunications will be required to continue "normal" business with decreased resources. Sharing the resources (hard copy printing, database update, etc.) will be required to further reduce costs and maintain the same commander support capability. This "office automation" should be available at most base IM functions to provide a hardware base for the proposed IM Net pubs/forms electronic library.

(4) Data element standardization will facilitate the exchange of information between various systems and the creation of a standard Air Force forms library.

4. Needed Capability:

a. General Operational Requirements:

(1) Electronic Libraries:

(a) MAJCOM, SOA, and Base IM's need the capability to access, update, distribute, and manage electronic libraries of Air Force and MAJCOM publication available in the AF SOS data base. The Chief, Base Information Management needs also to be able to add local base publications to the electronic library. This capability must provide the Base IM the options of making the electronic library available to the base population via the base-level net, through normal telephone lines by modem, as well as, forwarding electronic media copies of the library to large on-line, functional libraries. Organizations can then review the publications on screen and, if necessary, locally print a paragraph, a page, or a chapter to meet their specific requirements. They will not need to order or maintain complete publications to use one section.

(b) MAJCOM, SOA, and Base IM's also need the capability to access, update, distribute, and manage Air Force and MAJCOM electronic forms available in the AF SOS data base. The Chief, Base Information Management needs also to be able to add local base forms to the electronic library. This capability must include on-demand printing of (hard copy) blank forms for those organizations not yet using automated systems, and the capability to forward the blank electronic form image to customers who use office automation systems. These organizations can then fill in data on the form on-screen and, as required, print copies of the completed form or electronically transmit the information to its destination.

(2) Management Tools: Information Management must update the current IM standard system Publishing Distribution Office System (PDOS) to work effectively in the increasingly linked electroni environment. As originally designed, this stand-alone system helps the Chie . Base Information Management

to manage publications and forms distribution information in a paper dominated environment. We need to expand and integrate the system's capabilities to include the ability to work in a networked, multiuser, or shared resource mode and to better support the action officers and customers at the unit, base, and MAJCOM levels. We must modify this system to help Information Managers manage policy dissemination (publications) and data gathering (forms) methods, regardless of the media (paper, microform, or electronic). The PDOS (IM Net version) will be one module in IM Net to help the base IM track customer requirements for copies of the electronic libraries and usage of the master library. The current PDOS will remain a stand-alone system for those areas not able or not programmed to convert to using an electronic publications/forms library.

(3) Software Requirements. Delivered software must be mature, reliable, and maintainable to support rapid reprogrammability, growth capacity requirements, and especially (since it will be used down to the lowest level) user friendly operations. Software development will be IAW DOD STD 2167a.

b. Possible Solutions. In order to accomplish the general requirements listed above, every MAJCOM/Base IM needs to be able to provide his/her customers with access to these electronic libraries. (Attachment 8 contains a Requirements Correlation Matrix) To minimize costs, we considered only those solutions that made use of hardware and software from Air Force Standard Requirements contracts. We considered three approaches--1) consolidate all requirements and centrally acquire all hardware and software, 2) make use of existing personnel computers (PCs) on base as terminals to IM Net software and centrally acquire only the hardware/software for the Base IM, or 3) decentralize acquisition of hardware and software and centralize only software development. Attachment 1 lists assumptions used in this analysis; attachment 5 illustrates the relationship between IM Net and AF EOS (Air Force Electronic Publishing System); attachment 6 lists probable sites; and attachment 7 contains a spreadsheet used to calculate the following figures.

(1) (Not Recommended) Option 1--$39.5M 6 year cost. The first option identifies all the costs to the Air Force of the installed systems, however it fails to recognize that the projected productivity gains are in small increments (a few hours per month) spread throughout every office in the Air Force that uses Air Force regulations or forms. With this reality, it is impossible to pool these man-hour savings into a single pot and identify "offsets" that a centralized acquisition program can use to justify large dollar acquisitions. We expand this option mainly for the purpose of fully identifying the total costs to the Air Force of all components - the software development, the hardware at every base and every desk, the communications infrastructure needed, and the personnel training costs needed to provide a completely linked on-line library of Air Force, MAJCOM, and local publications and forms to every office Air Force-wide. See Attachment 2 for estimated costs.

(a) Purchase all hardware, cabling, interfaces, individual terminals, and connectivity.

(b) Develop and maintain (lowest level) user friendly software to allow access to this on-line library.

(c) Train or hire a full-time System Administrator to manage the hardware (network, multiuser, or shared resource), software, and library.

(2) (Not recommended) Option 2--$34.4M 6 year cost. Same as Option 1, except assumes base-level network infrastructure that precludes purchasing individual terminals for every library user. Option two assumes PCs exist on-base and can be connected through existing communications infrastructure to the Base IMs systems. It is included to show that, with or without a base network, overall costs to the Air Force of fielding a fully funded hardware system are an order of magnitude higher than Option three (See Attachment 3).

(3) (Recommended) Option 3--$2.8M 6 year cost. Option three decentralizes acquisition of any hardware/software and uses in place communications capability to provide service to individual units who want to access the electronic library of publications and forms. This recognizes that the projected benefits are in the offices of the units serviced by the Base IM and allows the individual local commanders to decide if they want to use the IM Net services. The local IM/SC staff can work together to develop the most cost effective implementation plan that uses the Air Force suite of standard computer hardware and includes use of any current hardware of communications infrastructure at the base. This option also recognizes that the only component that requires centralized control is the development of the IM Net unique software--which must be programed for and controlled through the Standard Systems Center (SSC) at Gunter AFB, AL. We recommend this as the best solution since it allows the local commanders along with the IM/SC staff to individually decide if they want to use the IM Net system and find the least expensive way to implement the services. (See Attachment 4.)

(4) All other possible solutions require separate development of nonstandard hardware and software; they were discarded.

5. Proposed Program.

a. Acquisition Strategy.

(1) Hardware. This program will utilize Air Force standard system (multiuser, networked, or shared resource) hardware and software (projected to be in place), which each MAJCOM/Base IM must procure individually from the Standard Systems contracts. Hardware acquisition is limited to SAF/AAI and SSC/SMLEA development and testing sites only.

(2) IM Application Software: SSC/SMLEA will convert the existing Information Management standard system, PDOS, and develop or obtain new software to allow access to electronic library of publications/forms. Working with SAF/AAI and the MAJCOM/IMs functional 702s and programers will analysis the requirements, determine the best method to program them, and produce and distribute IM Net software. SSC will be responsible for life cycle maintenance.

b. Schedule.

	START	COMPLETE	
Staff SON	Oct 89	Nov 89	
Coord SON	Dec 89	Jan 90	all
Validate SON	Feb 90		AF/CSRB
Approve SON	Feb 90		AF/CSRB
Software Development	Sep 92	TBD	SSC
Prototype Testing	Dec 92	TBD	Model Base
Software Distribution	TBD		
Software Maintenance	TBD		

c. Funding Profile.

A PDP package will be submitted for FY 92. If resources for SSC/SMLEA, dollars and manpower, are available in FY 90 and FY 91, development will start ASAP.

Projected Costs: ($ thousands)

(000)	FY 92	FY93	FY 94	FY 95	FY 96	FY 97
3400/SW Develop	400	400	400	400	400	400
3400/Tng Develop	20	40	40	20	10	10
3400/TDY	20	10	10	10	10	10
3400/Sup/Maint	14	14	14.5	14.5	14.5	15
	454.0	464.0	464.5	444.5	434.5	435.0
3080/Equipment	60	0	0	0	0	0

EDWARD A. PARDINI, Colonel, USAF
Acting Director of Information Management

10 Atch
1. Assumptions
2. Solution 1
3. Solution 2
4. Solution 3
5. Illustration
6. Probable Sites
7. Spreadsheet
8. RCM
9. Acronym List
10. Glossary
11. PDP

Approved.

26 JAN 1990

JOSEPH K. STAPLETON, Maj Gen, USAF
Chairman, CSRB Working Group

ASSUMPTIONS

1. The Base IM has a staff of approximately 25 people needing OA capability.

2. There will be at least one installed library for each identified Base IM.

3. CD-ROM presents extensive opportunities for "near-line" access of massive amounts of textual and data information, fully indexed for ease of referral.

4. The "standard" base requires approximately 130 simultaneous library users during normal duty hours.

5. Ten percent of on-line capability is required for dial-up (telephone) access.

6. A "shared resource" linked system will require a full-time System Administrator (SA).

Technical Solution 1

1. Assumes no network capability in existence anywhere.

2. Captures ALL costs to the government for IM Net capability insertion.

3. Costs:

Hardware (16 Ports/8 per)	
Multiuser	$ 45,119
CD ROM Jukebox	$ 5,000
Terminals (1)	$ 25,531
Connectivity	
DDN	$ 5,200
Dedicated Dial-up (2)	$ 13,000
Software	
Multiuser	$ 2,136
CAI Training	$ 5,032
Maintenance (3)	$ 18,658
Training (4)	
Personnel Pay	$ 21,933
System Administrator (5)	$ 42,000
Estimated Cost for one (1) installed system serving 128 simultaneous library users.	$ 183,609

IM Net Software Development Costs

Projected Costs: ($ thousands) (000)	FY 92	FY93	FY94	FY95	FY96	FY97
3400/SW Develop	$ 400	400	400	400	400	400
3400/Tng Develop	20	40	40	20	10	10
3400/TDY	20	10	10	10	10	10
3400/Sup/Maint	14	14	14.5	14.5	14.5	15
	454.0	464.0	464.5	444.5	434.5	435.0
3080/Equipment	60	0	0	0	0	0

Total IM Net Software (FY 92 to 97) Development/Maintenance Costs over 6 years to fully fielded:	$ 2,756,500
Total IM Net Hardware Acquisition Costs with 200 systems installed:	$ 36,721,800
TOTAL Costs for IM Net Installed	$ 39,478,300

Notes
1 115 Terminals as 90 percent of 16 ports, 8 users per port.
2 13 Dedicated Dial-up lines at $1000 per year.
3 Multiuser Maintenance for 6 years as part of initial purchase cost.
4 Cost of hours of training in Personnel Pay - includes training System Administrator & 128 library users.
5 System Administrator pay based on approximation of $65,000 per year for an officer and $30,000 for enlisted (FY 90 costs).

Technical Solution 2

1. Assumes base-level network capability in existence at all sites.

2. Assumes 90 percent of library users have networked terminal capability.

3. Captures costs to the government for IM Net capability insertion except terminals for ALL simultaneous users.

4. Costs:

Hardware (16 Ports/8 per)	
Multiuser	$ 45,119
CD ROM Jukebox	$ 5,000
Terminals (1)	$ N/A
Connectivity	
DDN	$ 5,200
Dedicated Dial-up (2)	$ 13,000
Software	
Multiuser	$ 2,136
CAI Training	$ 5,032
Maintenance (3)	$ 18,658
Training (4)	
Personnel Pay	$ 21,933
System Administrator (5)	$ 42,000
Estimated Cost for one (1) installed system serving 128 simultaneous library users.	$ 158,078

IM Net Software Development Costs

Projected Costs: ($ thousands)

(000)	FY 92	FY93	FY94	FY95	FY96	FY97
3400/SW Develop	400	400	400	400	400	400
3400/Tng Develop	20	40	40	20	10	10
3400/TDY	20	10	10	10	10	10
3400/Sup/Maint	14	14	14.5	14.5	14.5	15
	454.0	464.0	464.5	444.5	434.5	435.0
3080/Equipment	60	0	0	0	0	0

Total IM Net Software (FY 92 to 97) Development/Maintenance Costs over 6 years to fully fielded:	$ 2,756,500
Total IM Net Hardware Acquisition Costs with 200 systems installed:	$ 31,615,600
TOTAL Costs for IM Net Installed	$ 34,372,100

Notes
1 13 Dedicated Dial-up lines at $1000 per year.
2 Multiuser Maintenance for 6 years as part of initial purchase cost.
3 Cost of hours of training in Personnel Pay - includes training System Administrator & 128 library users.
4 System Administrator pay based on approximation of $65,000 per year for an officer and $30,000 for enlisted (FY 90 costs).

Technical Solution 3

1. Assumes base-level network capability in existence at all sites.

2. A PDP package will be submitted for FY 92.

3. If resources for SSC/SMLEA, dollars and manpower, are available in FY 90 and FY 91, development will start ASAP.

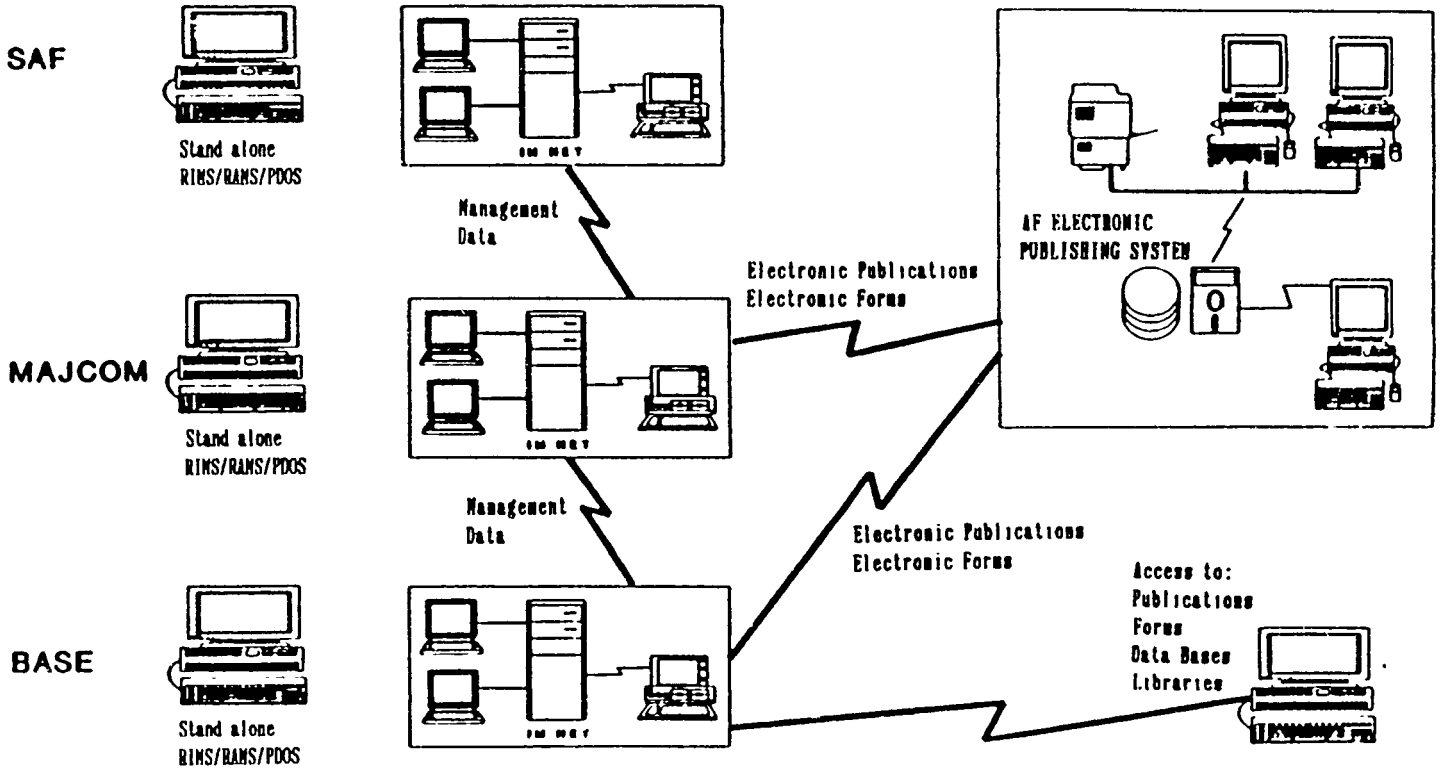
Projected Costs: ($ thousands)

(000)	FY 92	FY93	FY94	FY95	FY96	FY97
3400/SW Develop (4)	400	400	400	400	400	400
3400/Tng Develop	20	40	40	20	10	10
3400/TDY	20	10	10	10	10	10
3400/Sup/Maint	14	14	14.5	14.5	14.5	15
	454.0	464.0	464.5	444.5	434.5	435.0
3080/Equipment	60	0	0	0	0	0

Total IM Net Software (FY 92 to 97)
Development/Maintenance Costs
over 6 years to fully fielded: $ 2,756,500

4. Once funded SAF/AAIAI, in conjunction with MAJCOM representatives, will help SSC/SMLEA develop detailed taskings for software development--to include a detailed requirements analysis. IM Net software will be developed in modules which can be quickly tested and fielded.

INFORMATION MANAGEMENT STANDARD SYSTEMS



A6

Probable Sites

BASE	UNIT	OFC	MAJCOM
AFI	HQ AFI	MSIPD	TAC
Alpena	MIANG	SIC	ANG
Anchorage	176TAG	SIC	ANG
Anderson AFB	43 CSG	DAP	SAC
Andrews AFB	113TFW	SIC	ANG
Andrews AFB	ANGSC	CDA	ANG
Aurora	140TFW	SIC	ANG
Aviano AB	40MSSQ	DAPD	USAFE
Baltimore	175TFG	SIC	ANG
Bangor ANGB	101ARW	SIC	ANG
Battle Creek	110TASG	SIC	ANG
Bergstrom	67 MSSQ	MSIPD	TAC
Beale AFB	9CSG	DAPD	SAC
Bitburg, AB	36 CSG	DAPD	USAFE
Blytheville	97 CSG	DAPD	SAC
Boise	124TRG	SIC	ANG
Bolling AFB	1100ABG	DA	AFDW
Bridgeton	131TFW	SIC	ANG
Burlington IAP	158TFG	SIC	ANG
Cannon AFB	27MSSQ	MSIPD	TAC
Carswell AFB	7CSG	DAP	SAC
Castle AFB	93MSSq	DAPD	SAC
Chanute AFB	3345ABG	DA	ATC
Charleston	130TAG	SIC	ANG
Charlotte	145TAG	SIC	ANG
Cheyenne MAP	153TAG	SIC	ANG
Chicago	126ARG	SIC	ANG
Clark AB	3MSSQ	DAPD	PACAF
Clear AFS	13MWS	PDO	AFSPACE
Columbus AFB	14 MSS	DA	ATC
Comiso AB	487 CSG	DAPD	USAFE
Dallas	136TAW	SIC	ANG
Davis-Monthan	836MSSQ	MSIPD	TAC
Des Moines	132TFG	SIC	ANG
Dobbins AFB	94CSG	DAPD	AFRES
Dobbins AFB	116TFW	SIC	ANG
Dyess AFB	96CSG	DAP	SAC
East Granby	103TFG	SIC	ANG
Eastover	169TFG	SIC	ANG
Eielson AFB	343MSSQ	DA	AAC
Ellington AFB	147TFG	SIC	ANG
Ellsworth AFB	44 CSG	DAPD	SAC
Elmendorf AFB	21 CSG	DAPD	AAC
Elmendorf AFB	HQ	DAP	AAC
England AFB	23MSSQ	MSIPD	TAC
Fairchild AFB	141ARG	SIC	ANG
Fairchild AFB	92 CSG	DAP	SAC
Fargo	119FIG	SIC	ANG
FE Warren AFB	90CSG	DAPD	SAC
Florennes AB	485CSG	DAPD	USAFE

BASE	UNIT	OFC	MAJCOM
Fresno	144FIW	SIC	ANG
Ft Smith	188TFG	SIC	ANG
Ft Wayne IAP	122TFW	SIC	ANG
G. Pittsburgh	911TAG	DAPD	AFRES
Garden City	165TAG	SIC	ANG
Gen Mitchell AP	440TAW	DAPD	AFRES
George AFB	831MSSQ	MSIPD	TAC
Goodfellow AFB	3480ABG	DA	ATC
Grand Forks AFB	321CSG	DAP	SAC
Great Falls IAP	120FIG	SIC	ANG
Griffiss AFB	416CSG	DAPD	SAC
Grissom AFB	305CSG	DAPD	SAC
Hahn AB	50 CSG	DAPD	USAFE
Hellenikon AB	7206ABG	DAPD	USAFE
Hessisch-Oldend	600CSS	DAPD	USAFE
Hickam AFB	15ABW	DAPD	PACAF
Hickam AFB	PACAF	DAP	PACAF
Hill AFB	HQ	DAPD	AFLC
Hill AFB	419TFW	DAPD	AFRES
Holloman AFB	833MSSQ	MSIPD	TAC
Homestead AFB	31MSSQ	MSIPD	TAC
Howard AFB	24MSSQ	MSIPD	TAC
Incirlik AB	39CSS	DAPD	USAFE
Iraklion AB	7276ABG	DAPD	USAFE
Izmir AB	7241ABG	DAPD	USAFE
Jacksonville	129FIG	SIC	ANG
Kadena AB	18 CSW	DAPD	PACAF
Keesler AFB	3380MSQ	DA	ATC
Kelly AFB	HQ	DAPD	AFLC
Kelly AFB	149TFG	SIC	ANG
KI Sawyer AFB	41CSG	DAPD	SAC
Kirtland AFB	150TFG	SIC	ANG
Klamath Falls	114TFTS	SIC	ANG
Knoxville	134ARG	SIC	ANG
Kunsan AB	8 CSG	DAPD	PACAF
Lackland AFB	3700ABG	DA	ATC
Langley AFB	1MSSQ	MSIPD	TAC
Laughlin AFB	47 MSSQ	DA	ATC
Lincoln	155TRG	SIC	ANG
Lindsey AB	7100CSW	DAPD	USAFE
Little Rock	189ARG	SIC	ANG
Loring AFB	42CSG	DAPD	SAC
Louisville	123TRW	SIC	ANG
Lowry AFB	3415ABG	DA	ATC
Luke AFB	832MSSQ	MSIPD	TAC
MacDill AFB	56MSSQ	MSIPD	TAC
Madison	128TFW	SIC	ANG
Malmstrom AFB	341CSG	DAP	SAC
Mansfield	179TAC	SIC	ANG
March AFB	452AREF	DAPD	AFRES
March AFB	163TFG	SIC	ANG
March AFB	22CSG	DAP	SAC

BASE	UNIT	OFC	MAJCOM
Martinsburg	167TAG	SIC	ANG
Mather AFB	940AREF	DAPD	AFRES
Mather AFB	323 ABG	DA	ATC
Maxwell AFB	3800ABW	DAPD	AU
McChord AFB	446MAW	DAPD	AFRES
McClellan AFB	HQ	DAPD	AFLC
McConnell AFB	184TFG	SIC	ANG
McConnell AFB	384 CSG	DAPD	SAC
McGuire AFB	108TFW	SIC	ANG
McGuire AFB	170ARG	SIC	ANG
Memphis	164TAG	SIC	ANG
Meridian	186TRG	SIC	ANG
Milwaukee	128ARG	SIC	ANG
Minn-St Paul IAP	934TAG	DAPD	AFRES
Minn-St Paul IAP	133TAW	SIC	ANG
Minot AFB	91CSG	DAPD	SAC
Misawa AB	432 CSG	DAPD	PACAF
Moffett Field	129ARRG	SIC	ANG
Montgomery	187TFG	SIC	ANG
Moody AFB	347MSSQ	MSIPD	TAC
Mountain Home AFB	366MSSQ	MSIPD	TAC
Myrtle Beach AFB	347MSSQ	MSIPD	TAC
NAS New Orleans	926TFG	DAPD	AFRES
Nashville	118TAW	SIC	ANG
Nellis AFB	554MSSQ	MSIPD	TAC
New Castle	166TAG	SIC	ANG
New Orleans	159TFG	SIC	ANG
Newark AFS	HQ	DAPD	AFLC
Newburgh	105MAG	SIC	ANG
Niagara Falls IAP	914TAG	DAPD	AFRES
Niagara Falls IAP	107FIG	SIC	ANG
North Kingstown	143TAG	SIC	ANG
O'Hare ARFF	928TAG	DAPD	AFRES
Offutt AFB	55CSG	DAPD	SAC
Oklahoma City	137TAW	SIC	ANG
Onizuka AFB	1004SSG	DAPD	AFSPACE
Osan AB	51 CSG	DAPD	PACAF
Otis ANGB	102TFW	SIC	ANG
Peoria Aprt	182TASG	SIC	ANG
Peterson AFB	1003SSG	DAPD	AFSPACE
Peterson AFB	AFSPACE	PDC	AFSPACE
Pittsburgh IAP	171ARW	SIC	ANG
Plattsburgh AFB	380MSS	DAP	SAC
Pleasantville	177FIG	SIC	ANG
Portland IAP	142FIG	SIC	ANG
RAF Alconbury	10MSSQ	DAPD	USAFE
RAF Bentwaters	81 MSSQ	DAPD	USAFE
RAF Chicksands	7274ABG	DAPD	USAFE
RAF Fairford	7020ABG	DAPD	USAFE
RAF Greenham Common	501MSSQ	DAPD	USAFE
RAF Lakenheath	48 CSG	DAPD	USAFE
RAF Mildenhall	513MSSQ	DAPD	USAFE

BASE	UNIT	OFC	MAJCOM
RAF Upper-Heyford	20CSG	DAPD	USAFE
Ramstein AB	377CSW	DAPD	USAFE
Randolph AFB	12 ABG	DA	ATC
Reese AFB	3500MSQ	DA	ATC
Reno	152TRG	SIC	ANG
Richards-Gebaur	442CSG	DAPD	AFRES
Rickenbacker AFB	Det 1	SIC	ANG
Robins AFB	HQ	DAPD	AFLC
Robins AFB	HQAFRES		AFRES
Salt Lake City	151ARG	SIC	ANG
San Turce	156TFG	SIC	ANG
San Vito AB	7275ABG	DAPD	USAFE
Sandston	192TFG	SIC	ANG
Scotia	109TAG	SIC	ANG
Selfridge ANGB	127TFW	SIC	ANG
Semback AB	66 CSG	DAPD	USAFE
Sergeant Bluff	185TFG	SIC	ANG
Seymour Johnson AFB	4MSSQ	MSIPD	TAC
Shaw AFB	363MSSQ	MSIPD	TAC
Sheppard AFB	3750ABG	DA	ATC
Sioux Falls	114TFG	SIC	ANG
Soesterberg AB	32 TFS	DAPD	USAFE
Springfield	178TFG	SIC	ANG
Springfield	183TFG	SIC	ANG
St Joseph	139TAG	SIC	ANG
Swanton	180TFG	SIC	ANG
Syracuse	174TFW	SIC	ANG
Templehof Aprt	7350ABG	DAPD	USAFE
Terre Haute	181TFG	SIC	ANG
Tinker AFB	HQ	DAPD	AFLC
Topeka	140ARG	SIC	ANG
Torrejon AB	401MSSQ	DAPD	USAFE
Tucson	162TFG	SIC	ANG
Tulsa	138TFG	SIC	ANG
Tyndal AFB	325MSSQ	MSIPD	TAC
Van Nuys ANGB	146TAW	SIC	ANG
Vance AFB	71 ABG	DA	ATC
Vandenberg AFB	4392ASW	DAPD	SAC
Westfield	104TFG	SIC	ANG
Westhampton Bch	106ARRG	SIC	ANG
Westover AFB	439TAW	DAPD	AFRES
Whiteman AFB	351CSG	DA	SAC
Williams AFB	82 ABG	DA	ATC
Willow Grove	111TASG	SIC	ANG
Willow Grove AR	913TAG	DAPD	AFRES
Wright Patterson AFB	HQ AFLC	DAPD	AFLC
Yokota AB	475ABW	DAPD	PACAF
Youngstown MAP	910TAG	DAPD	AFRES
Zanesville	220EIS	DA	ANG
Zaragosa AB	406MSSQ	DAPD	USAFE
Zweibrucken AB	26 CSG	DAPD	USAFE

HARDWARE COST MODEL

	($thousands)
Multiuser System (1, 2 & 8)	$ 160.4
Jukebox	5
Dedicated Dial-up Lines (3)	13
Connectivity (DDN charges) (4)	5.2
Cost per installed System (5)	$ 183.6
Number of Installed Systems	x 200 (Attachment 6)
Cost of System Capability (5 &7)	$ 36,700

Notes

1. SMSCRC multiuser used for cost estimates.

2. Number of simultaneous users per port - 8. Number of Ports - 16.

3. Ten (10) percent capability dedicated to dial-up lines (13 lines). Each dial-up costs $1000.00 (five year install and rental).

4. DDN connectivity is WAG. AFCC specialists stste there is no connectivity cost to DDN concentrator if all communications are on base. DDN concentrator costs $108,000. Connectivity to this library may incur a fraction of that cost as attributable to IM. This is an estimate only.

5. Difference due to rounding error.

6. Terminals priced separately from hardware so comparison can be made without terminal cost.

7. Without cost of software development.

8.

Multiuser System	($thousands)
Hardware (9)	$ 45.1
Software (10)	2.1
Terminals (6)	25.5
Maintenance (6 years)	18.7
Training (CAI) - SW Cost (11)	5
Training Personnel Cost (12)	21.9
System Administrator	42
	$ 160.4

9. Hardware

3B2	$ 3,726	1	$ 3,726
CPU (24MHz)	3,848	1	3,848
Multiprocessor Enhancement	3,060	1	3,060
RAM (64MB) (4x16MB)	2,459	4	9,838
Console	265	1	265
Card (8 port)	370	3	1,111
Hard Disk (550 MB)	3,889	2	7,778
Printer, Laser	2,043	1	2,043
Printer, Drft Qual	445	2	890
Terminal	205	115	Separately Costed
Terminal Cable (50' ea)	18	115	Separately Costed
SCSI Adaptor	489	1	489
SCSI Host Adaptor Cable	58	1	58
DDN Interface	1,131	1	1,131
EMP feature	1,484	1	1,484
Modems (2400B)	262	13	3,407
Modem Cable	20	13	260
RS232 Terminated 25' Cable	17	1	17
RS232 Terminated 50' Cable	18	2	35
DDN Nul Modem 25' Cable	28	1	28
RS-449 Cable Unterminated	0.85	3000 ft	2,550
RS-449 Termination Kit - Male	13	1	13
RS-449 Termination Kit - Female	13	1	13
Cable Installed	1.52	3000	4,560
Total Hardware Items			$ 45,119

Included for information for faster response systems:

9600 Baud Modem Card	766	13	9,953
9600 Modem Case	1,382	1	1,382

10. Software

Operating System (OS)	$ 369	1	$ 369
UNIFY (database)	196	1	196
DDN	592	1	592
OA	306	1	306
ACCELL	40	1	40
PC-Interface	49	1	634
Total Standard Contract Software Costs			$ 2,136

11. Training Software (CAI) SA - Required for System Administrator

System Administrator (SA)	$ 72.34	1	$ 72
System Maintenance (SA)	51.61	1	52
System Utilities (SA)	27.79	1	28
ACCELL (SQL interface) (SA)	36.04	1	36
System Orientation (IM Office)	29.71	25	743
OA (Prelude)	162.03	25	4,051
RDBMS (Unify)	50.43	1	50
IM-NET	N/C	128	0
			$ 5,032

12. Training - Personnel Man-hour Costs

	Personnel Cost Per Hr	No. Hrs	Number Persnl Trained	Total Cost
System Administrator (SA)	$ 14.15	60	2	$ 1,698
System Maintenance (SA)	14.15	30	2	849
System Utilities (SA)	14.15	24	2	679
ACCELL (SQL interface) (SA)	14.15	10	2	283
System Orientation (IM Office)	14.15	6	25	2,123
OA (Prelude)	14.15	40	25	14,150
RDBMS (Unify)	14.15	12	2	340
IM-NET	14.15	1	128	1,811
				$21,933

13. Hardware Maintenance

	Each	Number	Monthly	Annual
HW - Basic Systems	174	1	174	$ 2,082
HW - Modems (2400)	4.11	13	53	641
HW - Terminals	.28	115	32	386
Total Hardware Maintenance Costs				$ 3,110

SOFTWARE DEVELOPMENT FOR INFORMATION MANAGEMENT BASE-LEVEL PUBLICATIONS/FORMS ELECTRONIC LIBRARY
REQUIREMENTS CORRELATION MATRIX (RCM)

PARAMETER	Requirements SON	Requirements SORD I	Requirements SORD II	Specifications SON	Specifications SORD I	Specifications SORD II	Test Criteria SON	Test Criteria SORD I	Test Criteria SORD II
Operational Requirements									
1. Current Capability									
a. Maintain PDOS (stand-alone)	yes(r)								
2. Additional Capabilities	yes(r)								
a. Publications									
(1) Fully indexed subject	yes(r)								
(2) User synonym assignment	yes(r)								
(3) Local Policy pointers	yes(r)								
b. Forms									
(1) Data element Standardization	yes(r)								
(2) Links to other systems DB	yes(g)								
(3) Image presentation	yes(r)								
c. PDOS (IM Net Version)									
(1) Provide system evaluation for resources programming	yes(r)								
(2) Provide local printing data	TBD								
3. Interfaces/Capabilities	yes(r)								
a. System Transparent Access	yes(g)								
b. System Transparent Help	yes(r)								
4. Interface with Non-IM Net Systems									
a. MAJCOM-unique	yes(r)								
b. Standard Base-Level	yes(r)								
5. System Survivability									
a. Contingency support	yes(r)								
b. Nuclear Protection	TBD								
6. Reliability and Maintainability	TBD								
a. Maximum Down Time									
b. Data Recovery Time									
7. System Availability	TBD								
8. Data Integrity	TBD								

LIST OF ACRONYMS

ADA	DOD Standard High Order Programming Language
AF 5OS	Air Force Electronic Publishing System (Contract Number)
AFCSA	Air Force Communications-Computer Systems Architecture
AFDW	Air Force District of Washington
APSE	Ada Programming Support Environment
BAS	Baseline Analysis Strategy
CAMS	Core Automated Maintenance System
CASE	Computer Aided Software Engineering (tools)
CCPS	Central Civilian Pay System
CD-ROM	Compact Disk - Read Only Memory
COBOL	Common Business Oriented Language
CSRB-WG	Communications-Computer Systems Requirements Board - Working Group
DBMS	Data Base Management System
DDN	Defense Data Network
DMS	Defense Message System
DMS-AF	Defense Message System-Air Force
DTAMS	Air Force Data Transmission and Message System
EDI	Electronic Data Interchange
FIPS	Federal Information Processing Standard
GKS	Graphical Kernel Standard
GOSIP	Government Open Systems Interconnection Profile
GSA	Government Services Administration
HOL	High Order Language
IEEE	Institute of Electrical and Electronics Engineers
IM	Information Management
IOC	Initial Operational Capability
ISDN	Integrated Services Digital Network
ISO	International Standards Organization
LOC	Lines of Code
MEN	Mission Element Need
MIPS	Millions of Instructions Per Second
OA	Office Automation
OS	Operating System
PCIII	Personnel Concept III
PDP	Program Decision Package
POM	Program Objective Memorandum
POSIX	Portable Operating System Interface for Computer Environments
RCM	Requirements Correlation Matrix
RFP	Request For Proposal

S1100	UNISYS 1100 Computer
SA	System Administrator
SAF/AAI	Secretary of the Air Force/Directorate of Information Management
SBLC	Standard Base Level Computer
SBLCC	Standard Base Level Communications-Computers
SDNS	Secure Data Network System
SOA	Separate Operating Agency
SON	Statement of Operational Need
SORD	System Operational Requirements Document
SOW	Statement of Work
SQL	Standard Query Language (database language SQL (FIPS 127)
SSC	Standard Systems Center
TOA	Total Obligation Authority
TSE	Target System Environment
TTP	TSE Transition Plan
ULANA	Unified Local Area Network Architecture
UNISYS	the prime contractor for the current SBLC & Desktop III
WORM	Write Once Read Many

GLOSSARY

Ada - Name of DOD standard high order programming language.

Application Software - computer programs that manipulate data. Can be word processors, database management systems, spreadsheets, graphics, telecommunications, and others.

Compatibility - the capability of two or more items or components of equipment or material to exist or function in the same system or environment without mutual interference.

Darkroom Environment - "no operator required" - These are systems designed to take advantage of self-initiation and self-recovery capabilities in both software and hardware.

Data Base Management System - a software system facilitating the creation and maintenance of an organized group of data and the execution of computer programs using the data for specific purposes (e.g. Reports, feedback, etc.)

Data Dictionary - a repository of information about data such as meaning, relationships to other data origin, usage, and format.

Data Element - A set of data items to be considered in a given situation as a unit. Synonymous with data item. Dictionary of Computers, Information Processing, and Telecommunications, 2d Ed., John Wiley & Sons, New York, 1987.

Data Item - The smallest unit of named data that has meaning in a schema or subschema. (ibid)

Distributed DBMS - a system in which the DBMS software manages data which is physically located on multiple computer systems.

ESD Quick-Cost Model - a software cost estimating model developed at the Electronic Systems Division.) The model takes attributes of the system and computes an estimated dollar-cost per line of code.)

Interoperability - the condition achieved among communications-computer systems or items of communications-computer equipment when information or services can be exchanged directly and satisfactorily between then and/or their users,

Local Area Network (LAN) a telecommunications system, within a specific geographical area designed to allow a number of independent devices to communicate with each other over a common transmission topology. LANs are usually restricted to relatively small geographical areas (e.g. rooms, buildings, or clusters of buildings) and utilize fairly high data rates.

Maintainability - a characteristic of design and installation which is expressed as the probability that an item will be restored to specific conditions within a given period of time when maintenance action is performed in accordance with prescribed procedures and resources.

MIPS - millions of instructions per second - units for measuring a computer s processor speed.

OS - operating system - the program which schedules tasks and allocates resources within a computer.

Portability - the extent to which items can be used on or with different systems. This term may be applied to programming languages and different types of computers or to programs and different operating systems. ("Dictionary of Computing"/Galland/1982)

POSIX - IEEE - standard for portable operating system interface for computer environments. It will provide vendor independent interface specification between an application program and an operating system.

Reliability - the probability that a system, subsystem, or equipment will perform a required function under specified conditions, without failure, for a specified period of time.

Supportability - the ability to satisfy requirements within established time frames require for mission effectiveness.

Survivability - the capability of a system to withstand a man-made hostile environment without suffering an abortive impairment of its ability to accomplish its designated mission.

TITLE: Information Management Network (IM NET)

BACKGROUND: IM-NET will provide the base level networked software tools so that the Base IM can receive, store, print, distribute, and manage electronic publications and forms which will efficiently deliver AF Policy (publications) to the reader. On-line master publications libraries and electronic functional libraries will provide immediate up-to-date information to commanders, their staff, and other personnel. IM Net will also provide electronic forms (information gathering tools) for use with computers and word processors. On-line electronic forms libraries, distribution of electronic copies of forms, and printing on-demand will provide immediate access to these information gathering tools for commanders, their staff, and other personnel, and let them complete the forms on a system, and print to a hardcopy or transmit electronically.

(000)	FY 92	FY93	FY94	FY95	FY96	FY97
3400/SW Develop	400	400	400	400	400	400
3400/Tng Devlop	20	40	40	20	10	10
3400/TDY	20	10	10	10	10	10
3400/Sup/Maint	14	14	14.5	14.5	14.5	15
	454.00	464.00	464.50	444.50	434.50	435.00
3080/Equipment	60	0	0	0	0	0

Notes: SW Development line pays for contractor support or civilian personnel for SSC/SMLEA. Training Development line pays for developing and fielding a CAI package to train users worldwide on how to use IM Net software. TDY line covers costs to attend functional workshops, requirements definition meetings, briefings, etc. Equipment and Supplies/Maintenance costs include the costs for hardware and software to establish developmental AF standard multiuser at SSC and SAF/AAIAI.

JUSTIFICATION: Mission readiness has been and continues to be impacted by Information Management's (IM) inability to disseminate Air Force policy and provide Air Force forms, regardless of media, in an accurate and timely manner. Air Force disseminates policy via Air Force publications and gathers and organizes information using forms, a labor intensive paper based system. Failure to fund IM Net will cause the continued loss of thousands of manhours in every Air Force office where clerks, secretaries, and action officers must manually order, file, and update(post) regulations or forms. Also offices will not be able to fully utilize already purchased computers/word processing packages without on-line electronic forms.

PDP # H576 Package Monitor: Lt Col Daviess, SAF/AAIA, ext 4-0657 Date: 01/19/90

TITLE: Information Management Network (IM Net)

BACKGROUND: IM Net will capture all Air Force publications and forms and enter them into an electronic database on CD ROMs. IM Net will make this database available as a local on-line electronic library managed by the local Base IM. On-line master publications libraries and electronic functional libraries will provide immediate up-to-date information to commanders, their staff, and other personnel. IM Net will also provide electronic forms (information gathering tools) for use with computers and word processors. On-line electronic forms libraries, distribution of electronic copies of forms, and printing on-demand will provide immediate access to these information gathering tools for commanders, their staff, and other personnel, and let them complete the forms on a system, and print to a hardcopy or transmit electronically.

(000)	FY 92	FY93	FY94	FY95	FY96	FY97
IM Net	2,151	7,282	12,208	17,113	2,988	2,988
OFFSETS:						
Printing	0	0	0	1,450	2,900	2,900
PDC Contract	0	0	0	550	1,100	1,100
Post&Frgt	0	0	0	550	1,100	1,100
	0	0	0	2,550	5,100	5,100

JUSTIFICATION: Mission readiness has been and continues to be impacted by Information Management's (IM) inability to disseminate Air Force policy and provide Air Force forms, regardless of media, in an accurate and timely manner. Air Force disseminates policy via Air Force publications and gathers and organizes information using forms, a labor intensive paper based system. Failure to fund IM Net will cause the continued loss of thousands of manhours in Air Force offices where clerks, secretaries, and action officers must manually order, file, and update (post) regulations or forms. Also, offices will not be able to fully utilize already purchased computers/word processing packages without on-line electronic forms.

PDP # H576 Package Monitor: Lt Col Daviess, SAF/AAIA, ext 4-0657 Date: 15/02/90

Appendix B: Electronic Library Questionnaire

Electronic Library Interview Questionnaire
Captain Michele M. Ohotnicky
AFIT/LSG/GIR

Demographics

Organization Name:

Industry Classification/Business Purpose:

Location/Locations:

Approx. Annual Budget:

Approx. Annual Information Budget:

Interviewee Name:

Title/Position in Organization:

Years with Organization:

Role in "Electronic Library" Project:

Project Name:

Brief Description of Project:

Nature of User Population:

Project Start Date:

Implementation Date:

Goals

1. How important are clear and specific goals/ objectives? (Circle one)

1 - Not Important 2 - Somewhat Important 3 - Important

4 - Very Important 5 - Crucial

2. Briefly, what were the projects stated goals/ objectives?

3. The following have been identified as important in evaluating whether CD-ROM technology is appropriate. Rate the following in terms of their importance in your initial considerations for the project.

1 - Not Considered 2 - Considered, but Not Important

3 - Somewhat Important 4 - Important 5 - Essential

_____ a. Low to Moderate (less than 20% Organization Budget) Budget

_____ b. Immediate Availability of Supporting Technology (e.g. sufficient amount of existing hardware)

_____ c. Need for Computer Searching (large amount of researching, complexity of search, or large volumes to be searched)

_____ d. Large Volume (at least 100 MB) of the Text

_____ e. Some Graphic Capability

_____ f. Data in Convertible Form

_____ g. Wide Range of Subjects (Diverse User Information Needs)

_____ h. Frequency of Updates (monthly, quarterly, etc.)

_____ i. Wide Distribution (at least 50 users)

_____ j. Reduce Online Costs

Background

4. What specific factors prompted your organization's interest in using CD-ROM technology to implement your project?

5. How was CD-ROM technology expected to support the organization's overall goals/objectives?

6. Were alternatives considered? What were they?

7.a. What opportunities did CD-ROM technology offer over the previous m hod?

b. Over the alternatives?

8. Was CD-ROM chosen?

Plan

9. How important is planning to a successful project?

1 - Not Important 2 - Somewhat Important 3 - Important

4 - Very Important 5 - Crucial

10. Was a formal plan for the project developed? Briefly describe the projects key "milestones."

11. How long did it take to develop the plan?

12. Was the project to be implemented organization-wide or in phases? (Full scale commitment--"testing the water")

13. Who were to be its "users?" (Did this hold true after implementation?)

14. Was your system primarily intended to support management at the strategic, tactical, or operational level?

15. In what ways was the project expected to change "the organization?" How was this incorporated into the overall plan?

16. How would you describe the initial response to the idea of CD-ROM technology on a continuum ranging from "enthusiastic" to "apprehensive?"

Boss _____

You _____

Users _____

17. Was the risk of the project considered to be high or low? Why? (Possible list, but not all inclusive:)

_____ size of project

_____ technological complexity

_____ task structure

_____ inexperience with technology

_____ stage of CD-ROM technological development

18. How important is information considered to be in your organization relative to other resources? (Low, Medium, High)

19. How important is the information produced by "the new system" relative to information in general? (Low, Medium, High)

Plan Development

20. How important is management support?

1 - Not Important 2 - Somewhat Important 3 - Important

4 - Very Important 5 - Crucial

21. To what extent was senior management support evident throughout the project in terms of:

1 - No Support 2 - Some Support 3 - Necessary Support

4 - Visible Support 5 - Total Support

_____ a. Clearly Defining Goals/Objectives

_____ b. Providing Resources (manpower, funding, etc.)

_____ c. Promoting Participation

_____ d. Being Open to Suggestions

22. How important is **developer competence**?

1 - Not Important 2 - Somewhat Important 3 - Important

4 - Very Important 5 - Crucial

23. Rate the project developers on the following issues:

1 - Poor 2 - Below Average 3 - Average

4 - Good 5 - Great

_____ a. Ability to Clarify Objectives (Requirements Definition i.e. working with users)

_____ b. Ability to Identify Objectives (Requirements Analysis)

_____ c. Responsiveness to Questions (Customer Support)

_____ d. Identification of Sources of Difficulty (Knowledgeable about process and programming)

_____ e. Accomplishment of Timely Modifications

_____ f. Documentation Clarity

_____ g. Training Support

24. To what extent did you perceive user involvement to be important to the development of this project? (Circle one)

1 - Not Important 2 - Somewhat Important 3 - Important

4 - Very Important 5 - Crucial

CD-ROM Development

25. What aspect of the conversion process did you find to be the most problematic? (Possible list:)

_____ Data capture

_____ Data conversion

_____ Hardware

_____ Software

_____ Hardware/software compatibility

_____ Other

26. What portions of the project (including conversion) did you accomplish "in-house" vice contracting? Would you change any of these decisions if you could do it over?

_____ Data Capture

_____ Data Conversion

_____ Premastering

_____ Encoding & Mastering

_____ Replication

_____ Labeling & Shipping

27. To what extent are "standards" important?

1 - Not Important 2 - Somewhat Important 3 - Important

4 - Very Important 5 - Crucial

28. Do you have any recommendations about standards based on your experience?

29. Did you have any problems related to product quality? How were standards established/ enforced?

30. Thinking in terms of the information flow from the initial capture of information to the ultimate users...

    a. What issues/processes are important in successfully creating the CD-ROM product to be distributed?

    b. What method do you use to disseminate/ transport CD-ROM to the users? What are the strengths and weakness of this method?

    c. What method did you previously use to disseminate information (prior to CD-ROM)? How do the costs of the current dissemination method compare with the previous method?

    d. Are you currently involved in CD-ROM networking as a means of disseminating information? At what stage in the information flow do you use networking technology?

    e. Have you found any limiting factors caused by current network technology?

    f. What kind of prior experience do your users have with computer searching in general?

1 - None 2 - Little 3 - Some

4 - Average 5 - Extensive

    g. What kind of prior experience do your users have with networking and communications protocols?

1 - None 2 - Little 3 - Some

4 - Average 5 - Extensive

h. Who have you found requires training and to what extent?

i. How often do you update you CD-ROM and how do you handle minor changes made between updates?

j. How do you determine whether computers are justified (due to complexity of searches, volume of information to be searched, number of searched required, or value-added capability) for a particular use?

k. How do you determine which form of access (networked versus stand-alone CD-ROM drive) is appropriate for a user or group of users?

31. Is there anything unique about CD-ROM technology that will impact the success or failure of its implementation in most organizations?

32. What criteria did you use to select the hardware for the project?

33. Are you happy with the performance of the select ed hardware? (If not, why not?)

34. Do you have any recommendations about the hard ware selection process? (Lessons Learned??)

35. What criteria did you use to select the retrieval software?

36. Which format standard does the software follow?

a. High Sierra
b. ISO 9660
c. Other
d. Unknown

37. Are you happy with the performance of the retrieval software? (If not, why not?)

38. Knowing what you do now, is there anything you would have done differently in selecting the software?

Success

39. List the projects stated goals/objectives and evaluate each as to the degree to which the goal/objective has been achieved. (Refer Question 2)

1 - Not Met At All 2 - Few 3 - Most

4 - Completely 5 - Beyond

40. Is system performance measured? If so, how?

_____ a. Efficiency

_____ b. Effectiveness

_____ c. Usage

_____ d. Customer Satisfaction

_____ e. User Satisfaction

_____ f. Boss's Satisfaction

_____ g. Minimum Training

_____ h. Other

Self Evaluation

41. Rate how satisfied your boss is with the project overall. (Circle one)

1 - Very Dissatisfied 2 - Dissatisfied 3 - Neither

4 - Satisfied 5 - Very Satisfied

42. What do you think most heavily influences your boss's perception of the project's success?

43. Rate how satisfied the users are with the project overall. (Circle one)

1 - Very Dissatisfied 2 - Dissatisfied 3 - Neither

4 - Satisfied 5 - Very Satisfied

44. How do you perceive your users would rate your "new system" in terms of:

1 - Not Important 2 - Somewhat Important 3 - Important

4 - Very Important 5 - Crucial

_____ a. Speed of Retrieval

_____ b. Accuracy

_____ c. Quality

_____ d. Timely Distribution (Subscriptions)

_____ e. Ease of Use

45. What to you think most heavily influences the users perceptions of the projects success?

46. Rate how satisfied you are with the project overall. (Circle one)

1 - Very Dissatisfied 2 - Dissatisfied 3 - Neither

4 - Satisfied 5 - Very Satisfied

47. What issues do you perceive to be the most critical to the success of a project such as this?

Review

48. Rate the following in terms of their importance to development and implementation of an "electronic library."

1 10
|----------|
Not Important Crucial

_____ a. Clear and Specific Objectives

_____ b. Impact of Organizational Change

_____ c. Planning

_____ d. Identification of Needs

_____ e. Perceived Risk

0 10
|----------|
Not Important Crucial

_____ f. Management Support

_____ g. Developer Competence

_____ h. User Involvement

_____ i. Data Format Standards

_____ j. Data Compression Standards

_____ k. Retrieval Software Standards

_____ l. Hardware Interface Standards

_____ m. Internal Organizations Standards (CALS)

_____ n. System Performance

49. Describe some of the unexpected events during the project. (Formal Lessons Learned?)

50. In retrospect, is there anything you would have done differently?

51. Is there anything that can be done prior to development to promote success?

Case Analysis

The Air Force proposes converting their approximately one million pages of policy guidelines (e.g. publications and forms) to a digitized form on CD-ROM. The project involves distribution of text (75%) and graphics (25%) information to users at 200 widely distributed locations. Updating of approximately 1% of the information will be required on a quarterly basis. The information is in the process of being digitized as part of the current publishing process. What problems or concerns would you anticipate for a project like this? What would you recommend?

Appendix C: Points-of-Contact Providing Background

Major James W. Duggan (Interview September 21, 1989)
Director of Information Management
Air Force Logistics Command
Wright-Patterson AFB OH

Major Karl Vercio and Gordon Kirkpatrick
(Telephone - November 11, 1989)
Chief, Publications and Forms Management
Bolling AFB DC

Jerry McFaul
(CD-ROM Presentation at FOSE 1990 - March 22, 1990)
U.S. Geological Survey
Chairman SIGCAT
Reston VA

Matthew Leek
(CD-ROM Presentation at FOSE 1990 - March 22, 1990)
Meridian Data Inc.
Scotts Valley CA

Paul Zisset, Bob Marskie, and Mike Farrell
(CD-ROM Presentation at FOSE 1990 - March 22, 1990)
Bureau of the Census
Washington DC

Bill Peterson
(CD-ROM Presentation at FOSE 1990 - March 22, 1990)
Patent and Trademark Office
Washington DC

Laurie Amichetti
(CD-ROM Presentation at FOSE 1990 - March 22, 1990)
Electronic Systems Division
Hanscom AFB MA

Major Thomas S. Kelso (Interview May 16, 1990)
Assistant Professor of Space Operations
Air Force Institute of Technology
School of Engineering
Wright-Patterson AFB OH

Captain Kenneth Baird (Telephone May 18, 1990)
Model Base Program
Mather AFB CA

Captain Jeff Nelson (Telephone May 18, 1990)
Model Base Program
Barksdale AFB LA

John Sands
(FOSE 1990 - March 22, 1990 and Telephone June 6, 1990)
Nimbus Information Systems

Phil Flynn (Telephone June 6, 1990)
Wright State University Library
Fairborn OH

Lieutenant Colonel Zier (Telephone June 11, 1990)
Headquarters U.S. Air Force Legal Services
Denver CO

Linda Kuntz (Telephone June 18, 1990)
National Oceanic and Atmospheric Administration
Washington DC

Art Mungia (Interview June 18, 1990)
Professor Air Force Institute of Technology
(AFTOMs and JUSTIS)
Wright-Patterson AFB OH

Lieutenant Commander Robert J. Clarey
"A Review of the Evolution of Naval Data Automation and the Optical Media Mass Storage Alternatives Related to Naval Aviation Technical Documentation" (MS Thesis September 1987)
Naval Postgraduate School
Monterey CA

Lieutenant Commander Bruce E. France, Sr.
"Moving Optical Technology In-house" (MS Thesis March 1989)
Naval Postgraduate School
Monterey CA

Lieutenant Kenneth P. Butrym and
Lieutenant Hagop A. Avedissian
"CD-ROM; Library of the Future" (MS Thesis June 1988)
Naval Postgraduate School
Monterey CA

Leo Pozo (Telephone June 25, 1990)
Army Publication
Warner Robins AFB GA

Susan David (Telephone July 12, 1990)
Library of Congress
Washington DC

Appendix D: Interview Subject Matrix

Matrix

Project (Representative)	Text	Graphic	Keyword Search	Volume (10K pgs)	Wide Distr	CD-ROM
AF Acquire (MARS) (Lt Shankin)	Y	?	Y	Y	Y	Y
DEARAS (Vince Prichard)	Y	Y	Y	Y	Y	Y
Corps of Eng. (Ken Kercheval)	Y	Y	Y	Y	Y	Y
Paperless Ship (Jeff Orner)	Y	Y	Y	Y	N	N
Author Anderson (Cathy Gries)	Y	Y	Y	N	Y	Y
AEGIS (Capt Margolis)	Y	Y	Y	Y	N	N
Mead Data Central (John Holt)	Y	Y	Y	Y	Y	Y
Wright State Un. (Phil Flynn)	Y	N	Y	Y	Y	Y
U.S. Patent & Trd (Bill Lawson)	Y	Y	Y	Y	Y	Y
Library of Congr (Susan David)	Y	N	Y	Y	Y	Y
Acct Res & Proc Coca Cola Company (Wayne Reed)	Y	Y	Y	Y	Y	Y
GE Power Gen Serv (Sue Lohnas)	Y	?	Y	?	Y	Y
Compaq QUICKFIND (Nora Rice)	Y *	? *	Y *	? *	? *	Y *
U.S. Geological S (Beverly Westermeyer)	Y	Y	Y	Y	Y	Y

Matrix (cont.)

	Text	Graphic	Keyword Search	Volume (10K pgs)	Wide Distr	CD-ROM
JEDI U.S.G.S. Jerry McFaul	Y	Y	Y	Y	N	Y
The Computer Lib (Eileen Picken-paugh)	Y	Y	Y	Y	N	Y
FEDLOG (1Lt Shagena)	Y	N	Y	Y	Y	Y
AFTOMS/JUSTIS (Art Mungia)	Y	Y	N	Y	Y	N
Leo Pozo (Army Pub's)	Y	Y	Y	Y	Y	Y
Naval Res. Lab Lib (Doris Folen)	Y	N	N	Y	N	N
Info LAN (Norma Hill)	Y	N	Y	Y	Y	Y
MultiMedia Encycl (Frank Stanley)	Y	Y	Y	Y	Y	Y
C.E. Model Base (Capt Martin)	?	?	?	?	?	?
Pentagon Library (Carol Bursick)	?	?	?	?	?	?
HMIS Dataware (Wilcox)	Y	?	Y	Y	Y	Y
HAZMAT EPA (???)	Y	?	Y	Y	Y	Y
Gehman Library George Washington University Debra Bezanson	Y	?	Y	Y	?	?

Matrix (cont.)

	Text	Graphic	Keyword Search	Volume (10K pgs)	Wide Distr	CD-ROM
MACPAC Mann Library Cornell Univ. (Bill Coons)	Y	?	?	?	?	?
SIGACE Education Dept (Sheldon Fischer)	Y	?	?	?	?	?
mithsonian (Glenn Hopkins)	Y	Y	Y	Y	?	?
ZIP +4 U.S Postal Serv (????)	Y	?	?	Y	Y	?
TIGER Dept of Commerce (????)	N	Y	N	Y	Y	Y
Nimitz Library Ruth Hennesey	Y	?	?	?	?	?
Maintenance Man Edwards AFB CA (?????)	Y	Y	?	?	?	Y

* Phone call resulted in user response that the company doesn't discuss its technological developments

? Identifies situations where information unknown

Appendix E: Project Descriptions

Project A

Program Manager: Jeff Orner
U.S. Naval Sea Systems Command
Fleet Logistics Support Branch Head
Washington D.C.

Developer: Single Contractor

Budget: $1.5 million (pieced together 6 Navy budgets)

Project Name: Advanced Technical Information System ("paperless ship")

Description: Single prototype of technical manuals and drawings on 60-5 1/4" WORM discs to support ships (workstations and library) and shipyard (engineers and workstations). Run parallel paper and WORM on ship as "break-in". Users include ships and shore maintainers as well as engineers. Long run use WORM to master CD-ROM for availability Navy-wide.

Project Dates: Started June 1988. Implementation June 1990 on U.S.S Ingraham.

Project B

Program Manager: Cathy Gries
Consultant
Arthur Andersen & Company
Public Accounting and Consulting Firm
Chicago IL (250 offices worldwide)

Developer: In-house for data preparation and contracted pre-mastering, mastering, and replication
Hardware: Toshiba
Software: Time Management Inc.

Budget: Confidential, but FY 89 accounting and consulting fees over $3 billion

Project Name: The Audit Reference and Resource Disc (ARRD)

Description: Equip worldwide auditors with portable CD-ROM drives and discs with 150 frequently used reference sources and 30 software applications. Initial project 1200 CD-ROM drives and applications for worldwide field auditors. Auditor experience ranged from never

having touched a PC to some experience. Bulk of users no experience. Strong reliance on Microsoft Windows software to aid users. Software on CD-ROM with special licensing agreements set precedent in price structuring.

Project Dates: Started in the summer of 1986. First pilot disc became available May 1987 at 4 offices for field testing among 6 special interest groups.

Project C

Program Manager: John Holt
Senior Staff Software Engineer
CD Director of Inter-Market Planning

Pat Guyant
Legal Product Manager

Mead Data Central
Electronic Publishing Firm
Centerville OH

Developer: In-house
Hardware: Sony
Software: Fulcrum and Folio

Budget: Confidential--Revenues 1989 totalled $440 million

Project Name: Poisons and Poison Control Procedures

Description: Develop product for Denver subsidiary Micro Medics to convert information on microfiche to CD-ROM for access using search and retrieval software. Product consists of full text and tabular information to be indexed for use in hospital emergency rooms. Users would be hospital technicians and staff.

Project Dates: Started approximately mid-1986. Implemented in 1987.

Project D

Program Manager: First Lieutenant Larry Schankin
U.S. Air Force
Electronic Systems Division
Air Base Decision Systems
Systems Software and Design Center
Hanscom AFB MA

Budget: $8 million

Developer: Multiple Contractors
Hardware: Hitachi

Project Name: MCCR Acquisition Library System (MALS)
ACQUIRE

Description: Prototype disc of Federal Acquisition Regulations. Distributed to 60 beta test sites throughout Air Force and Department of Defense to ascertain technological potential and promote.

Project Dates: Started early FY '87. Implemented Spring 1987.

Project E

Project Manager: Ron Kercheval *
U.S. Army Corps of Engineers
Printing and Publications Program Manager
Washington D.C.

* Most vocal in promoting CD-ROM cost savings. See:
PC Computing - February 1990
Government Computing News - March 23, 1990
Federal Computer Week - June 25, 1990
CD-ROM EndUser - December 1989

Developer: Single Contractor
Hardware: Sony Model 6100
Software: Fulcrum

Estimated Project Cost: $175,000

Project Name: CD-ROM Pilot Project

Description: Transfer corps documents (regulations, manuals, and technical letters) and forms onto CD-ROM. Test sites: 8 for publications and 47 for forms. Users included field engineers and lawyers.

Project Dates: Started November 1988. Implementation has been on-going.

Project F

Project Manager: Vincent Prichard
Acting, Chief of Legal Research Division
Air Force Legal Information Service
HQ USAF/JASL
Denver CO

Developer: None at this time. Basing request for proposal on video disc prototype developed three years ago. Expect contract September 199C

Budget: Unknown

Project Name: Defense Emergency Authorities Retrieval and Analysis System (DEARAS)

Description: Provide subset of Federal Legal Information Through Electronics (FLITE) database for emergency authorities of the U.S. Converting online database information to be used as stand-alone database in the field during emergency. Request for portable computer as opposed to laptops. Users would include emergency planners and command post operators.

Project Dates: Started 1987 with video disc. Goal for implementation in FY '91.

Project G

Program Manager: Wayne Reed
Program Manager
The Coca-Cola Company
Atlanta GA

Developer: In-house data preparation
Contractor for pre-mastering and mastering
Hardware: Hitachi
Software: Electronic Text Corp. "Word Cruncher"

Budget: Confidential--several $billion

Project Name: Optical Disc

Description: Convert accounting manuals and create an electronic set of policies and procedures manuals for the company using CD-ROM. Completely textual information. Users would be accounting professionals, finance managers, and division managers.

Project Dates: Started in March 1987. Implementation delayed until October 1990 while obtaining license for software.

Project H

Program Manager: Captain Sheldon Margolis
Commanding Officer
Aegis Training Center
U.S. Navy
Dahlgren VA

Developer: Multiple Contractors

Budget: $5 billion

Project Name: Aegis Optical Technology Project - Training Support

Description: Conduct pilot project for interactive technical manuals and ensuring compliance with CALS. Final project to use light pen or touch screen instead of keyboards. 20 tons of paper technical manuals aboard ship. Aegis Training Center library holds 100 manuals occupying 1/2 million cubic feet which are impossible to maintain. Current goal is to get it to work and modify as required by users (rapid prototyping).

Project Dates: Started in May 1990. Goal is to implement aboard 7 test ships within 2 years.

Project I

Program Manager: Doris Folen
Head of Document Section
Ruth L. Hooker Naval Research Library
Washington D.C.

Developer: Single Contractor
Hardware: Sony & SUN
Software: Online Computer Systems

Budget: Unknown

Project Name: Optical Disc Project

Description: Putting full text unclassified technical reports onto optical discs. Immediate need is to avoid loss of information due to reduction in available storage space. High

volume and archival nature resulted in selection of 12" WORM medium. Users were primarily scientists and researchers.

Project Dates: Started in March 1988. Implemented in June 1989.

Project J

Program Manager: Norma Hill
Assistant Director
Howard County Library
Columbia MD

Developer: Independent contractor.
Software: Optinet and Meridian Data, Inc.

Budget: $1.3 million

Project Name: Info LAN

Description: Local area network (LAN) of 12 commercial databases available to public singly or simultaneously at 6 workstations. Project involved development of LAN and integration of optical hardware and software to share optical databases as well as providing direct access within the library setting. Primary purpose was to improve service to customers. Databases were linked via multi-disc drives and a process known as daisy-chaining. Variety of publishers and search retrieval software employed made the effort "sporty." The databases included:

1. UMI Periodical Abstracts/New Abstracts
2. Grolier Encyclopedia
3. Silverplatter's ERIC
4. MEDLINE
5. Ziff Davis - The Computer Library
6. Microsoft - Bookshelf
7. Microsoft - Small Business Consultant
8. Corporate and Industry Research Reports

9-12 Peterson College (4 products)

* Physicians Desk Reference

*Added since project was initiated

Project Dates: Started August 1988. Implemented April 1989. April deadline was critical to ensure continued funding.

Appendix F: Summary of Interview Results

Goals

1. How important are clear and specific goals/objectives?

Crucial	A,B,C,I,J
Very Important	D,E,F,G,H
Important	
Somewhat Important	
Not Important	

2. Briefly, what were the project's stated goals/objectives?

   A - Reduce paper, improve ease of access, automate process, reduce printed products in storage and storage space requirements by providing print on demand, and promote open architecture/CALS compatibility.

   B - Decrease cost of supplying reference material to to on-site auditors and consultants. Increase productivity, efficiency, and effectiveness. Decrease printing and distribution costs.

   C - Replace microfiche product and allow keyword search. Increase retrieval and decrease publication time.

   D - Investigate CD-ROM media. Spread word about capability. Help other organizations getting involved in CD-ROM.

   E - Decrease costs associated with printing, distributing, and storing printed material (postage, building maintenance, card box costs, etc.)

   F - Provide access to emergency authorities without use of telephone communications.

   G - Provide electronic access to company's written policies and procedures. Create pathway for other departments to follow with mass database storage capabilities.

   H - Conduct pilot project of interactive technical manuals and comply with CALS (Computer Aided Logistics Support) DOD attempt to ensure compatibility of systems across services.

I - Put text reports on optical disc to reduce space and improve retrieval for librarian, scientists, and researchers.

J - Improve operations and services. Make most of available grants.

3. The following have been identified as important in evaluating whether CD-ROM technology is appropriate. Rate the following in terms of their importance in your initial considerations for the project.

a. Low to moderate budget

Essential	A
Important	F,J
Somewhat Important	G,H
Considered, but Not Imp	B,D
Not Considered	C,E,I

b. Immediate availability of supporting technology

Essential	A,F,J
Important	B,D,E,G,H
Somewhat Important	C
Considered, but Not Imp	
Not Considered	I

c. Need for computer searching

Essential	A,B,C,F,G,H,I
Important	D,E
Somewhat Important	J
Considered, but Not Imp	
Not Considered	

d. Large volume of text (100 MB+)

Essential	A,C,F,H
Important	B,E
Somewhat Important	
Considered, but Not Imp	D,G
Not Considered	I,J

e. Some graphic capability

Essential	A,H
Important	E,G,I
Somewhat Important	C,D
Considered, but Not Imp	B
Not Considered	F,J

f. Data already in convertible form

Essential	A,G,H,I
Important	B,C,D,E
Somewhat Important	F
Considered, but Not Imp	
Not Considered	J

g. Wide range of subjects or diverse user needs

Essential	A
Important	B,C,H,J
Somewhat Important	
Considered, but Not Imp	C,D,E,F
Not Considered	I

h. Frequency of updates

Essential	A
Important	B,C,E,G,H,J
Somewhat Important	F
Considered, but Not Imp	
Not Considered	D,I

i. Wide distribution

Essential	B,D,G,H
Important	A,C,E,J
Somewhat Important	
Considered, but Not Imp	F
Not Considered	I

j. Reduce online costs

Essential	G
Important	
Somewhat Important	F,J
Considered, but Not Imp	C
Not Considered	A,B,D,E,H,I

Background

4. What specific factors prompted your organization's interest in using CD-ROM technology to implement your project?

   A - Storage capacity

   B - Firm belief in technology and commitment to PCs. Auditors facing information overload with too many sources to get to quickly and accurately. Simplify, standardize, and automate.

C - Customer recognized CD-ROM as great alternative to microfiche. Perfect database for hypertext.

D - Mass storage capability and low cost of distribution.

E - Increasing costs of postage, storage, personnel, and printing.

F - Need for stand alone system without reliance on telephone communications.

G - Cost savings. Ability to be more competitive. Bridge to future.

H - 20 tons of technical manuals aboard ship!

I - Reduce volume--space critical, causing risk of losing unclassified documents.

J - Long range plans to use technology to enhance operations and services. Boolean search capability improves accessibility. Receipt of corporate grants made networking possible.

5. How was CD-ROM technology expected to support the organization's overall goals/objectives?

A - Increase availability. Improve efficiency of distribution at reduced costs.

B - Increase efficiency and effectiveness of field auditors.

C - Replace microfiche in emergency room. Faster better service.

D - Demonstrate technology capability and promote use throughout Air Force and DOD.

E - Improve engineer's access to corps data.

F - Provide distributed database with high level of integrity and portability.

G - Long term: create transparent interface among various platforms. Company-wide access to goals/objectives. Easier to implement due to distribution capability and accessibility.

H - Long run: eliminate all paper technical manuals.

I - Allow salvaging reports that could be "preserved" for future research.

J - Extremely literate population results in library being one of the most popular in country. Waiting lines at information desk were getting extremely long. User access to database could significantly reduce lines.

6. Were alternatives considered? What were they?

A - WORM, CD-ROM, and paper.

B - CD-ROM, online databases, WORM, large hard drive.

C - Staying online--local data essential.

D - No

E - No

F - WORM--didn't need to update that often and technology not as developed as CD-ROM.

G - Magnetic tape, removable hard drives, microfiche, WORM, erasable optical, and satellite links.

H - All. WORM, magnetic tape and disk drives. May end up going back to one of these, but right now CD-ROM has storage capability.

I - Microfiche, microfilm, CD-ROM, WORM, moving paper to another location, or destroying.

J - Expand online services and stand alone CD-ROM databases.

7. What opportunities did CD-ROM offer over the previous method? Over the alternatives?

A - Reduce weight and storage space on ship. Increase efficiency by improving accessibility with retrieval software.

WORM for single prototype and CD-ROM to take advantage of mass replication and economies of scale.

B - Integrity of data. High volume at low cost. PC compatibility.

People were not using online database due to questioned integrity. CD-ROM provided data integrity users required.

C - Improve search ability. No cost benefit over online.

Users needed local access and CD-ROM appeared an affordable alternative.

D - Not Applicable

No alternatives considered.

E - Mass storage at reasonable cost and decreased postage.

No alternatives considered.

F - Same information as online, but doesn't require telephone communications.

Data can't be changed inadvertently.

G - Other ways to spend $500,000 saved in postage. Decrease time professionals spend researching (reduce "page turners"). Should be able to visualize answers as fast as we come up with questions.

Integrity of data. Cost savings in distribution and productivity. Availability of hardware.

H - Lower cost and improved updating. 4.72" CD-ROM easier storage due to volume, weight, and durability for capacity of information.

Durability made storage of large volume of information easier.

I - Reduces storage space, provides permanent preservation, allows almost instant recovery. Microfiche requires twice the space of optical changer (device used for updating and reading WORM disc).

CD-ROM not large enough.

J - Decrease online costs and improve user access.

Online only alternative and advantages as described above.

8. Was CD-ROM chosen?

Yes	B,C,D,E,F,G,H,J
No	I*
Planned	A

* Using Write Once, Read Many (WORM) Optical Discs

Plan

9. How important is planning to a successful project?

Crucial	A,B,C,G,H,I,J
Very Important	D,E,F
Important	
Somewhat Important	
Not Important	

10. Was a formal plan for the project developed? Briefly describe the project's key "milestones."

A - "Rapid prototype" - use or lose money. Production phase 6 months to ship delivery. Milestones:
1) Scan data
2) Test software
3) Ensure data and software compatible (multiple contractors)
4) Build index (immensely complicated)

B - Yes. Milestones:
1) Information Plan
2) User Needs Analysis
3) Database Design
4) Software Design
5) Application Development and Testing
6) Production

C - Yes. Milestones:
1) Develop own search and retrieval software
2) Plan and define prototype
3) Data prepared
4) Test (Crucial due to poison liability)
5) Quality check data and product
6) Package and distribute
7) Develop "jukebox" and lash PCs with server to LAN

D - No. Pressed (terminology used to describe the creation of new CD-ROM discs with "new" master and replication) couple of different versions with different search and retrieval software and surveyed users.

E - Yes. Milestones:
1) Get seed money from engineering section
2) Get documents scanned (OCR & raster)
3) Set up test sites
4) Statement of work for Phase I.
5) Plan Phase II

F - Yes. Milestones:
1) Acquire and test hardware
2) Acquire and test search and retrieval software
3) Develop user interface
4) Convert data
5) Produce CD-ROM
6) Documentation
7) Acquire and deliver ordered system
8) Final report

G - Yes. Milestones:
1) Project plan
2) Convert data (already electronic - easy)
3) Mock-up disc (test environment on WORM)
4) Completed disc (includes testing and labeling)
5) Distribute

H - Yes. Under development.

I - No. Informal-- Identify what we wanted to do, how to get money and hardware. Support of people and procurement. Installation and operation.

J - Yes. Milestones:
1) Grants received--assembled planning team
2) Generate "wish list"
3) Hire consultant to help develop request for proposal for networking, create position and description for head of information services, and determine hardware and network needs.

11. How long did it take to develop the plan?

0 - 1 month	A,G
2 - 3 months	B,E,J
6 months	F
Not complete	H
Varies	D
Unknown	C
Not applicable	I

12. Was the project to be implemented organization-wide or in phases? (full scale commitment versus trial project)

A - Navy-wide implementation dependent upon trial project. Phased implementation.

B - Intended for field auditors organization/ worldwide. Phased approach.

C - Exploring technology for client (trial). Parallel conversion.

D - Many trial databases and search and retrieval strategies to learn about technology.

E - Sounded like the answer to cost and storage need so initiated test project (trial). Phased approach.

F - Testing 2 systems (HQ & Pentagon) and then produce as ordered over 5 years.

G - Senior management tasking (full commitment). Phased implementation.

H - Test project, but at the same time restatement of Navy commitment to "paperless ship". Phased approach.

I - Trial project to ascertain whether current technology can provide a feasible solution to library storage problem. However, dollars invested forced a high level of commitment upon the organization. Would like to scan information in and network so report information would be available remotely.

J - Trial project to explore new technology applications in addressing service desk problems. Temporary nature of research grants are a "one time" opportunity. Phased approach.

13. Who were to be its "users?" (Did this hold true after implementation?)

A - Ship personnel, engineers at planning yards, and administration in development, stocking, and printing technical data. Don't know yet.

B - Field auditors. Yes.

C - Emergency Medical Technicians (EMT). Expanded through hospital with LAN.

D - Air Force and DOD acquisition and procurement personnel. Yes.

E - Engineers and corps library. Unlimited potential due to "one man shop" program managers.

F - Emergency planners and command post personnel. Not applicable at this time (not implemented).

G - Initially, accounting professionals, finance managers, and senior executives. Now, attorneys and technicians.

H - Students, operators and maintainers aboard ship. Not applicable at this time (not implemented).

I - Scientist and library administrative staff. Yes, so far.

J - General public. No, Department of State, Japanese businessmen in addition to residents, college students, and businessmen.

14. Was your system primarily intended to support management at the strategic, tactical, or operational level?

Strategic	I
Tactical	
Operational	F
All	D,E,G
None (users)*	A,B,C,H,J

* These subjects emphasized their projects were not intended to support management, but directed towards users/operators.

15. In what ways was the project expected to change "the organization?" How was this incorporated into the overall plan?

A - It was not expected to change the organization.

B - The project was expected to increase efficiency and effectiveness. Provide graphical user interface.

C - The project was "client" oriented and change in our organization is not applicable.

D - The project was not expected to change the organization because it is our business to experiment with technology.

E - Reduce time people need to locate information. Feature built in indexes and retrieval software.

F - No expectation for organizational change.

G - Professionals need to use keyboard. Culture shock in Europe. Recruit locals to assimilate change and train.

H - No change to "the organization" is expected.

I - The project is not expected to change "the organization."

J - Improve operations and service by providing public access to database.

16. How would you describe the initial response to the idea of CD-ROM technology on a continuum ranging from "enthusiastic" to "apprehensive?"

Boss	Enthusiastic	A,B,E,F,G,I,J
	Concerned	C
	Apprehensive	D,H
You	Enthusiastic	A,B,D,E,F,G,H,I,J
	Mixed	C
Users	Enthusiastic	B,C,D,H,I,J
	Mixed	A,E,G
	Unknown	F

17. Was the risk of the project considered to be high, or low? Why?

High	A,E,G,I
Low	C,D,F
Moderate	B,H (Subjects stated neither high nor low)

A - Short time frame to develop and implement.

B - Technology new, lacked experience and no one to look to for advice.

C - Small project size.

D - Inexperience with technology, but viewed as low in complexity. Stage of CD-ROM development somewhat of a concern, but risk kept low by keeping abreast of changes.

E - Inexperienced with technology, but viewed as low in complexity. Key issue and concern getting straight answer about stage of CD-ROM development. "Canned" demonstrations indicate very developed, but when pinned down admit still in infancy and much still unknown.

F - Prototype 3 years ago using video disc technology--we know what we want to do and how to do it.

G - Company's overall response to change is slow, making personal risk high. Inexperienced with technology, but view more tedious than complex.

H - Size overwhelming--hundreds of thousands of technical manuals converted. Data conversion difficult due to non-standard and dated documents. Changing technology hard to keep up with. "DOD can't drive industry" subject to what industry is willing to provide. CALS (Computer Aided Logistics Support) standards aren't set yet.

I - Cost, inexperience, and no one to turn to for advice.

J - No one was even considering networking at the time. Publishers shocked when we called. Figured we could still use stand alone if network didn't work.

18. How important is information considered to be in your organization relative to other resources?

High ALL

19. How important is the information produced by "the new system" relative to information in general?

High ALL

Plan Development

20. How important is management support?

Crucial	A,B,C,G,I,J
Very Important	D,E,F,H
Important	
Somewhat Important	
Not Important	

21. To what extent was senior management support evident throughout the project in terms of:

a. Clearly Defining Goals/Objectives

Total Support	B,C,E,G,I,J
Visible Support	A,F
Necessary Support	D
Some Support	
No Support	H

b. Providing Resources (manpower, funding, etc.)

Total Support	A,B,E,G,I,J
Visible Support	C,D,F
Necessary Support	
Some Support	H
No Support	

c. Promoting Participation

Total Support	B,E,G,J
Visible Support	A,C,F
Necessary Support	D
Some Support	H
No Support	I

d. Being Open to Suggestions

Total Support	A,B,E,G,I,J
Visible Support	F
Necessary Support	D
Some Support	C,H
No Support	

22. How important is developer competence?

Crucial	A,B,D,E,G,I,J
Very Important	F,H
Important	C
Somewhat Important	
Not Important	

23. Rate the project developers on the following issues:

a. Abiility to Clarify Objectives

Great	B,E,G
Good	A,C,D*
Average	D*
Poor	
Not Applicable	F,H,I,J

b. Ability to Identify Objectives

Great	A,B,E,G,J
Good	C,D*
Average	D*
Poor	
Not Applicable	F,H,I

c. Responsiveness to Questions

Great	A,B,E,G,J
Good	D*,H
Average	C,I
Poor	D*
Not Applicable	F

d. Identification of Sources of Difficulty

Great	A,B,E,G
Good	C,D*,H,J
Average	
Poor	I
Not Applicable	D*,F

e. Accomplishment of Timely Modifications

Great	B,E,G,J
Good	A,H
Average	C,D*
Poor	D*,I
Not Applicable	F

f. Documentation Clarity

Great	B,E,G,J
Good	A
Average	
Poor	D*,I
Not Applicable	C - Manual imbedded in software no one uses.
	D*- Subcontracted some work.
	F - Not selected yet.
	G - Not this far yet.

g. Training Support

Great	B,E,G,J
Good	
Average	C
Poor	I
Not Applicable	A,D,F,H

* Multiple contractors involved and rated separately.

24. To what extent did you perceive user involvement to be important to the development of this project?

Crucial	B,G,H
Very Important	A,C,D,E,F
Important	J
Somewhat Important	
Not Important	I

CD-ROM Development

25. What aspect of the conversion process did you find to be the most problematic?

A - Changing CALS standards--decisions needed to be made about data format, SGML (Standard Generation Markup Language), etc. weren't settled--forced us to project what standards will be in the future to ensure compliance with DOD compatibility. Raster scanning.

B - Processing data for conversion labor intensive (re-keying, scanning, SGML tagging) and potential for overruns in budget and deadlines high.

C - Data conversion. Mismatch in content architecture because not using SGML tags consistently. Hardware compatibility.

D - Data capture due to time and money involved in converting paper to digital.

E - Data capture and conversion due to 100% in paper format only. Resolving hardware compatibility due to some users not having 100% IBM compatible PCs.

F - Data conversion--experience with video disc prototype similar to CD-ROM. Plan to create master tape using BRS Search (can be specified in contract) so online database can be maintained in its current format.

G - Data conversion. Using hardware, software, and emulation devices to get file into usable form. Lack of standards in word processing environment complicates conversions of existing electronically captured data. Getting into form needed becomes nightmare.

H - Data capture. Technical manual format is not suitable for direct "tag" or hypertext conversion. End product still in tech manual form which requires reading from screen. Requirement to avoid keyboard and focus on light pen or touch screen results in unavailability due to conversion difficulty. Phase II to develop technician capability.

I - Reliance on optical character recognition (OCR) scanners means that some data will be lost. This may be less of a problem now with the promising developments in scanner technology as well as increased use of raster scanning.

J - Hardware and software compatibility (networking). Lack of data format standards results in conflicts among the various search and retrieval strategies and the various search and retrieval programs were often designed to be supported by specific hardware systems. Multiple products required dealing with each vendor to resolve these conflicts and enable network operation. This proved extremely time consuming.

26. What portions of the project (including conversion) did you accomplish "in-house" vice contracting? Would you change any of these decisions if you could do it over?

A - None.

No, there are great cost and planning advantages to contracting.

B - Data collection, some data preparation, and packaging and shipping.

No, although we're now involved in pre-mastering and small amount of mastering. Originally, too much needed to be done.

C - Data capture and conversion.

No.

D - Packaging and shipping only.

No--go with experience.

E - None.

No--let them do it.

F - None.

Not applicable.

G - Data capture and conversion. Packaging and shipping so quality control checks could be made.

Might try pre-mastering based on knowledge acquired about technology.

H - Initial project none.

No, but future plans include in-house data conversion, and in the long run pre-mastering and a replication facility.

I - Currently none.

Yes, would do data conversion in-house due to poor results with current contractor.

J - Not Applicable.

27. To what extent are "standards" important?

Crucial	A,B,H
Very Important	D,E,F,G,J
Important	
Somewhat Important	
Not Important	I
*Depends on environment	C

28. Do you have any recommendations about standards based on your experience?

A - Military services should focus on coordinating during CALS development.

B - Develop standards up front prior to data conversion to save a lot of time.

C - Consistency more important than standards.

D - Need for common indexing specification about how information is put on disc.

E - Stick with ISO 9660, CCITT Group 4 and data compression boards as opposed to software.

F - No.

G - ISO 9660 satisfactory.

H - Flexibility to ensure maximum hardware use.

I - Don't wait for them--make them.

J - Data format standards to increase the ability to use products of various vendors on standard systems with standard software. Encourage standardized search strategies.

29. Did you have any problems related to product quality? How were quality standards established/enforced?

A - Data conversion of paper and aperture cards up to 15 years old, so no standard format which created scanning difficulties. Government agencies did quality assurance checks.

B - Standards weren't as tight as they should have been. Different standards due to judgment calls had a direct impact on quality.

C - Random checks revealed quality not much of a problem.

D - Data integrity problems. Performance flaws in search and retrieval software. Spelling errors. Previous dealings with vendor were great: they said they would do quality checks and we believed them. Problem tied to sub-contractor--took on more work than they could handle.

E - Left up to vendor. Super job! Scanned paper products to produce exact image of paper and therefore able to do quality checks by comparing to physical copy.

F - Not this far yet.

G - None.

H - Problem at data level--poor quality of printed products being scanned.

I - Some software problems with indexing and inverted indexes. Initially, retrieval only by 6 digit accession number, but have expanded to word-by-word due to improved scanning technology.

J - Occasionally get a bad disc and only way to isolate is to check everything else.

30. Thinking in terms of the information flow from the initial capture of information to the ultimate users..

a. What issues/processes are important in successfully creating the CD-ROM product to be distributed?

A - Identify how to package (specific users need or everyone gets copy of everything).

B - Up front planning for data format.

C - Ensuring composition and publishing systems are correct and support intra- and inter-document linkages (editorial tagging) instead of SGML.

D - Getting data into magnetic form. If can't be done in-house, be sure to check thoroughly for quality.

E - Solicit user comments and incorporate good suggestions.

F - Defini.. the database and data conversion.

G - Identify the data to be distributed. Identify the users. Review information system culture and how sophisticated. Determine how important user is to final product. Plan how to change culture.

H - Having properly formatted technical manuals. Updates and maintaining the change process.

I - Retrieval of information on disc.

J - N/A

b. What method do you use to disseminate/transport CD-ROM to the users? What are the strengths and weakness of this method?

A - Plane and U.S. Mail. Reliable and no change to previous procedure.

B - Mail and normal distribution through organization. No change needed.

C - Express Mail. Same as before and could still reduce costs.

D - U.S. Mail. Did not evaluate based on strengths and weakness, but most cost efficient.

E - U.S. Mail at $.85 versus varied costs last year. Not new to users and cost advantage due to reduced volume and weight.

F - U.S. Mail. Not considered.

G - Courier pouch service. Considered valuable information and handled as before at reduced cost due to volume and weight reduction.

H - Hand carry--single prototype, but uncertain about future (security issues). Strength: secure. Weakness: costly.

I - Not Applicable.

J - Not Applicable.

c. What method did you previously use to disseminate information (prior to CD-ROM)? How do the costs of the current dissemination method compare with the previous method?

A - Same--U.S. Mail, but significantly reduced costs due to reduction in volume and weight.

B - Same distribution channel but information greatly compressed. Hard dollar savings (one particular book required by all accountants cost $1,000,000 to produce and distribute--in CD-ROM takes up less than 2% of the disc and costs $100,000).

C - Express mail and costs about the same.

D - Not Applicable.

E - Same--U.S. Mail, but much cheaper.

F - Online system on mainframe over public data network--our goal was to get away from online. Costs not really considered, just needed to improve emergency response.

G - Same--courier pouch service, but 95% cost savings using CD-ROM (one manual weighing 8 lbs. cost $380 to deliver to South Africa plus $37 to produce--most expensive CD-ROM total cost $7.50).

H - Paper. All ships were sent all changes and they decided what was applicable. Providing all information on disc and print on demand eliminates significant amount of overprinting. Like to be out of the paper business in 5 years. School holds 1/2 million cubic feet of paper in library, 100 copies of manuals and can't keep up with the changes. CD-ROM availability will reduce storage by 1/4.

I - Same--allow to read off screen and print as needed.

J - Not Applicable.

d. Are you currently involved in CD-ROM networking as a means of disseminating information? At what stage in the information flow do you use networking technology?

A - Yes, plan file server at ship library accessible by ship workstations and file server at shipyard to multiple workstations.

B - No, geographically dispersed and need portability as well as availability off-site.

C - No, "jerry rigged" jukebox system to reference questions.

D - No, but future projects will.

E - Yes, test beginning first part of July using Novell Netware. Much more difficult due to megabytes of data transfer required on forms (bit mapped and compressed).

F - N/A--want portability of stand alone.

G - Yes, in 2 locations used as backup.

H - No.

I - Not Applicable.

J - Yes, a file server and 6 workstations accessing 12 commercial databases. Serve as extension of reference desk and research stimulator.

e. Have you found any limiting factors caused by current network technology?

A - Not yet, too early to tell.

B - Lack of standardization.

C - No, enough jukeboxes to handle a lot of discs.

D - CD-ROM has to run on established LAN and there are limits on the amounts of available software. Not all CD-ROM will run on any software. The software simply hasn't been written yet.

E - Didn't know enough about, so will test Novell, Banyon, and 3Com and get user response.

F - Not Applicable.

G - Yes, tested at three sites. Not real happy because it's slow.

H - Not Applicable.

I - Not Applicable.

J - Yes, available RAM due to LAN requirements and CD-ROM driver requirements reduces number of applications you can run on network.

f. What kind of prior experience do your users have with **computer searching** in general?

Extensive	I
Average	E,J
Some	F,G
Little	B,C,D
None	H

*Mixed range from None to Extensive A

g. What kind of prior experience do your users have with networking and communications protocols?

Extensive	I
Average	C,G,J
Some	E
Little	A,B,D,F
None	H

h. Who have you found requires training and to what extent?

A - All require initial familiarization, but retrieval software so easy it self teaches.

B - All initial--2 hours self study tutorial or with working knowledge of Windows reduces to about 1 hour. Information obtained from feedback "hotline" identified more hardware glitches than software problems.

C - Everyone needs to learn search syntax.

D - Basic how to turn computer on. No special training.

E - General office personnel with limited PC experience.

F - Anticipate initial training as part of job.

G - Europeans, except for Germans. Change culture that thinks keyboarding is demeaning.

H - Can't answer yet, but it takes around 10-20 minutes to learn to use ERIC database.

I - None.

J - Staff at varying levels to ensure they can meet their responsibilities to their customers. All require in-depth knowledge of various search strategies and the search and retrieval commands for the different databases. If they don't have the answer to a question, they must know who does.

i. How often do you update your CD-ROMs and how do you handle minor changes made between updates?

A - Not applicable--WORM changes made as necessary.

B - Quarterly updates. Full-time staff updating database daily. Hard copies for interim changes through bulletins (specific needs).

C - Quarterly updates to CD and diskettes with updates (change index pointers on hard drive that override CD-ROM index).

D - Not Applicable.

E - Semiannual.

F - Annual and modify with floppy to be put on hard drive with search and retrieval software. Contractor looking into using disk mountable hard drive.

G - Quarterly updates. Issue accounting change memorandum in paper at rate of 3 or 4 per month.

H - Annual scheduled updates. Minor changes with floppy d

I - Not Applicable.

J - According to publishers' schedules.

j. How do you determine whether computers are justified (due to complexity of searches, volume of information to be searched, number of searched required, or value-added capability) for a particular use?

A - Volume of information to be searched.

B - Volume of information and firm's commitment to PCs.

C - Market research client's willingness and ability to pay for value-added.

D - Not Applicable.

E - Questionnaire.

F - Based on need for portability and stand-alone capability.

G - Commitment to automating information processes. Company-wide information network by interfacing PCs with "mainframe power" at fingertips.

H - Mass of paper. Need to get rid of volume without losing information. Access time and ability to update.

I - In general all libraries are finding computers are so much faster and more efficient.

J - Advice of microcomputer specialist and LAN administrator.

k. How do you determine which form of access (networked versus stand-alone CD-ROM drive) is appropriate for a user or group of users?

A - Amount of resource sharing needed.

B - Knowing end user needs.

C - How critical is the information and inability to rely on communications structure.

D - Number of users, time and number of accesses to CD-ROM, and location of users.

E - User survey questionnaire.

F - No need to share database.

G - Job function (sensitive information not LAN) and geographic locations.

H - Not Applicable.

I - Not Applicable.

J - Received grant money and determined products (full text) take too much RAM.

31. Is there anything unique about CD-ROM technology that will impact the success or failure of its implementation in most organizations?

A - Volume of data and can't be altered.

B - Criteria: 1) Economies of scale (large enough)
2) Relatively static information
3) High value of contents
4) Speed is an issue (faster is better)
5) Hardware/software investment and savings.

C - Particular answer to local storage.

D - Getting information into magnetic media for mastering.

E - No. Simple to use. Carry a warehouse in your pocket.

F - Collecting data and putting into format needed. CD-ROM itself is easy to use.

G - Unique to microcomputer--stronger, better, faster.

H - Good set of standards would seem like any other application.

I - Requires more than basic computer knowledge. Biggest drawback to WORM is cost.

J - Cost.

32. What criteria did you use to select the hardware for the project?

A - Competition for contract

B - Long term company vision required vendor stability and desire to establish long term relationship (looking for a partner willing to work with us). Good after sale support. Customize drive to fit briefcase. Performance, audio capability, internal/external, battery power, international product, and compatibility.

C - Best price and feature function. Availability. Cost. Proven performance.

D - GSA contract. Name brand. Detailed features. Beta test 15 systems.

E - Recommendation of FedLink librarian and GPO. Ease of operation.

F - All commercial off-shelf "system" purchase with maintenance for 386 or 486 microcomputers.

G - Mean time between failure, worldwide availability and service, and cost.

H - Z-248 compatible with minor modifications for shipboard.

I - Auto-changer needed. Sony only one working and Sun most efficient to support Sony for volume.

J - Cost. Track record. Optinet support for matching hardware to software.

33. Are you happy with the performance of the selected hardware? (If not, why not?)

Yes	B,C,D,E,G,I
No *	H,J
Not Applicable	F
Too Early	A

* H - Required to ensure compatibility with Z-248s which are very old and very slow.

* J - Multiple drives are sensitive to dirt and you lose four drives when one goes down. Keeping a backup gets expensive.

34. Do you have any recommendations about the hardware selection process? (Lessons Learned??)

A - Stick with what is commercially and competitively available. Controlled somewhat by need to integrate.

B - Know company dealing with and quality reputation. Relationship shouldn't end with purchase.

C - Bring in-house and test.

D - Use other companies evaluations, CD-ROM EndUser and CD Report reviews as guides.

E - Stay with IBM compatible.

F - Not Applicable.

G - Doesn't work well with mainframes. First find out how you are going to get repaired. Check equipment yourself.

H - Lease it, don't ever buy. Haven't had a successful ADP equipment buy in the Navy ever. Let someone else decide on equipment 3 years from now when companies are better established.

I - Yes, ask to see system in operation. Decipher "real" from "dreamware." More difficult with WORM than CD-ROM. Pin down on delivery time.

J - Know what you want to do before you set up specifications for product.

35. What criteria did you use to select the retrieval software?

A - Looking for commercial "off-shelf" or something Navy could own rights to and be able to send to multiple locations.

B - Write own when you can. Seek programming support from outside the organization when necessary--key is finding company willing to work with you. Customize functional design in-house and vendor did coding.

C - What features are required to meet functional needs and are optional features worth their cost. What kind of text retrieval software w. l suffice and whether speed is important. (Remember this is the online and very profit motivated organization looking to meet customer needs at minimum cost.)

D - Features. Speed of access and ease of use for end user.

E - Features. Searching ability. Highlight words. Ease of operation.

F - Maximum flexibility in selection of prototype. Reviewed a lot of full-text retrieval products over 3 years. BRS much fuller depth of search connectors (referring to Boolean search connectors such as AND, NOT, OR, etc. and the various combinations that can be used).

G - Lowest common denominator machine--must be able to drive mainframe size files in PC with 640K and 2 floppy drives. Company still around in 3 years when things are growing.

H - Contracted and demonstrated.

I - What was available at the time for WORM. New request for proposal (RFP) out for software.

J - Market availability for networking very limited.

36. Which format standard does the software follow?

High Sierra	A
ISO 9660	B,C,D,E,F,G
Unknown	H,J
Not Applicable	I

37. Are you happy with the performance of the retrieval software? (If not, why not?)

Yes	A,B,C,E,G,J
No *	D,I
Not Applicable	F
Too Early	H

* D - Our fault. Did not know enough to ask for certain features and the company we were dealing with was also inexperienced.

* I - Not right now. Buggy and not compatible with programs we would like to buy.

38. Knowing what you do now, is there anything you would have done differently in selecting the software?

Yes *	C,D
No	A,B,E,G,H,I,J
Not Applicable	F

* C - Use developed "off-shelf" and custom built software. Boolean search within sentence.

* D - Pay for experienced company.

Success

39. List the project's stated goals/objectives and evaluate each as to the degree to which the goal/objective has been achieved. (Refer Question 2)

1- Not Met At All 2 - Few 3 - Most

4 - Completely 5 - Beyond

Summary of Goal/Objective Achievement

Project	Goals	1	2	3	4	5
A	Reduce Paper				X	
	Ease of access				X	
	Storehouse				X	
	CALS				X	
	Automate process & modernization			X		
B	Increased efficiency					X
	Decrease cost of supplying, printing, and distributing					X
C	Replace microfiche					X
	Improve retrieval				X	
	Decrease publication time			X		
D	Investigate CD-ROM					X
	Spread the word					X
	Help other organizations					X
E	Decrease costs					X
F	Not Applicable					
G	Provide electronic policies and procedures on CD-ROM					X
H	Pilot project			X*		
	Compliance with CALS			X*		
	(* Not at full implementation)					
I	Decrease space				X	
	Improve retrieval	X**				
	(** WORM technology in early stages of development)					
J	Improve operations and and services					X

40. Is system performance measured? If so, how?

a.	Efficiency	B,G,I
b.	Effectiveness	B,G,H,I
c.	Usage	B,D,J
d.	Customer Satisfaction	B,C,D,E,F,G,H,J
e.	User Satisfaction	B,D,E,G
f.	Boss's Satisfaction	B,D,G,I
g.	Minimum Training	B
h.	Other*	A,B

*A - Group of decision makers determines success after a series of demonstrations.

*B - Improved client's services.

Self Evaluation

41. Rate how satisfied **your boss** is with the project overall.

Very Satisfied	A,B,C,D,E,G,I,J
Satisfied	
Neither	H
Dissatisfied	
Very Dissatisfied	
Not Applicable	F

42. What do you think most heavily influences your boss's perception of the project's success?

A - Met expectations and schedules.

B - Use and improved service.

C - Revenue.

D - Depth and breadth of user applications. Visibility of Air Force and DOD. Other tasks spawned.

E - Customer and user satisfaction.

F - Not Applicable.

G - Money savings. Cost centers not profit centers. To save is divine.

H - Beneath level of his interest.

I - Sees as leading edge technology.

J - Patron response.

43. Rate how satisfied the **users** are with the project overall.

Very Satisfied	B,C,D,E,G,J
Satisfied	G,H
Neither	
Dissatisfied	
Very Dissatisfied	
Not Applicable	A,F,I

44. How do you perceive your **users** would rate your "new system" in terms of:

a. Speed of Retrieval

Crucial	B
Very Important	C,D,E,H,J
Important	G
Somewhat Important	
Not Important	
Not Applicable	A,F,I

b. Accuracy

Crucial	B,C,D,G
Very Important	E,H,J
Important	
Somewhat Important	
Not Important	
Not Applicable	A,F,I

c. Quality

Crucial	B,C,D,G
Very Important	E,H,J
Important	
Somewhat Important	
Not Important	
Not Applicable	A,F,I

d. Timely Distribution (Subscriptions)

Crucial	B
Very Important	C,D,E,G,J
Important	H
Somewhat Important	
Not Important	
Not Applicable	A,F,I

e. Ease of Use

Crucial	B,G
Very Important	D,E,H,J
Important	C
Somewhat Important	
Not Important	
Not Applicable	A,F,I

45. What do you think most heavily influences the users' perceptions of the project's success?

A - Not applicable due to incomplete implementation i.e. not enough users have had hands on system.

B - Ease of use due to retrieval software and Windows.

C - Speed and accuracy.

D - Ease of access to data.

E - Ease of operation.

F - Not applicable as project is still in development.

G - Ease of use. No training--just sit down and use.

H - Increase tactical tools available. Ease of maintenance.

I - Not applicable as project is only 10 percent complete.

J - Effectiveness of individual searches.

46. Rate how satisfied you are with the project overall.

Very Satisfied	A,B,C,D,E,I,J
Satisfied	G
Neither	
Dissatisfied	H
Very Dissatisfied	
Not Applicable	F

47. What issues do you perceive to be the most critical to the success of a project such as this?

A - Schedule and system performance.

B - Meet end-user needs.

C - Focus on what user need/wants and narrow.

D - Data converted to digital form. Frequency of updates. User resistance.

E - Funding. Customer comments.

F - Not Applicable.

G - Planning.

H - DOD not integrated enough. Need one organization in charge.

I - Top management support very important. Availability of technical knowledge and money.

J - Planning (RFP well done) and assignment of LAN Administrator (identify person needed and specify responsibilities).

Review

48. Rate the following in terms of their importance to development and implementation of an "electronic library." 1 (Not Important) ----------> 10 (Crucial)

Factors:
a. Clear and Specific Objectives
b. Impact of Organizational Change
c. Planning
d. Identification of Needs
e. Perceived Risk
f. Management Support
g. Developer Competence
h. User Involvement
i. Data Format Standards
j. Data Compression Standards
k. Retrieval Software Standards
l. Hardware Interface Standards
m. Internal Organizations Standards (CALS)
n. System Performance

Ratings Matrix

Factor	B	C	D	E	F	G	H	I	J	Mean	Std Dev
a.	10	10	9	10	8	9.5	8	10	10	9.39	.858
b.	10	5	9	10	2	7	5	1	5	6.00	3.279
c.	10	10	9	10	8	10	8	10	10	9.44	.882
d.	10	10	9	10	8	10	8	10	10	9.44	.882
e.	5	2	3	5	2	2	5	8	5	4.11	2.028
f.	10	7	7	10	8	9.9	5	10	10	8.54	1.869
g.	10	7	10	10	10	9	5	8	8	8.56	1.740
h.	10	6	7	9	7	9	10	10	5	7.11	2.892
i.	5	0	9	9	6	8	8	10	5	6.67	3.082
j.	5	0	9	9	5	8	8	10	8	6.89	3.100
k.	5	2	2	10	5	2	8	6	7	5.11	2.848
l.	5	5	10	10	6	10	8	10	10	8.22	2.279
m.	10	9	8	10	1	8	8	1	1	6.22	3.993
n.	7	7	20	20	8	10	8	10	10	8.89	1.364

49. Describe some of the unexpected events during the project. (Formal Lessons Learned?)

A - Twice as long to get contract in place. Variety of formats and quality. Constant issues with CALS standards--having to guess which way standards would go. Getting hands on hardware fast enough to stay on schedule.

B - Ambiguous standards. User perspective from field. Consistency--people do things differently.

C - Problems with installation of hardware, software, and files.

D - Contractor sub-contracting problem.

E - Nothing except fire in March which proved value of product.

F - Not Applicable.

G - Hard Disk failure. Need to budget for license fee for software. P-Edit (brand name of conversion software) macros were used with WordPerfect to convert data. 600 files in 2 hours.

H - Surprise management change. Worked out better than expected.

I - So much "vaporware" and "dreamware." Procurement takes longer than you ever expect.

J - Netbios (Network Basic Input/Output System) problem forced early changes.

50. In retrospect, is there anything you would have done differently?

A - Started earlier, but given nature of situation doesn't think possible.

B - Standards up front. Have in-depth understanding of user needs, develop standards, and then get management blessing before starting application.

C - Identify who the information is important to. Samplings to see if people would buy.

D - Know more about technology.

E - No

F - No

G - No

H - Found some more money. Speed of progress seems slow, but considering the number of independent projects--moving about as fast as we can.

I - No. Success attributable to luck!

J - More lead-time to complete.

51. Is there anything that can be done prior to development to promote success?

A - Decision on CALS standards

B - Planning--resolve issues early.

C - Get data uniform.

D - Talk to unbiased (users and implementors) as opposed to those with vested interest.

E - Create interest and the need.

F - Good identification of needs and clearly state so you know what you need to do.

G - Planning--find out causes of failure, what works, and what predicated decisions.

H - Convince right people program is right because we can't keep up with changes anymore. Get users excited.

I - Get as much information as possible and set a rational time goal.

J - Knowing what users needs are and publicizing projects.

Case Analysis

The Air Force proposes converting their approximately one million pages of policy guidelines (e.g. publications and forms) to a digitized form on CD-ROM. The project involves distribution of text (75%) and graphics (25%) information to users at 200 widely distributed locations. Updating of approximately 1% of the information will be required on a quarterly basis. The information is in the

process of being digitized as part of the current publishing process. What problems or concerns would you anticipate for a project like this? What would you recommend?

A - Problems: Conversion. This can be easy or hard. It is much easier with raster scanning and QA (Quality Assurance) can be accomplished. Navy tries giving raster "intelligence" by developing "tagging." No real means of QA. Another problem could be in-house development of search and retrieval software. It is difficult unless you have the expertise and is a very critical element of the CD-ROMs success. Competence is essential and procurement of rights to software is not too difficult.

B - Problem: Conversion. Necessary to get information into electronic medium since 80-85% of time and effort can be ported into future technologies. Recommend doing end-user needs analysis. CD-ROM is distribution medium to handle 600MB and your application appears to demand much larger capacity, but it does offer the portability, integrity, and durability it appears you need. Retrieval software is definitely needed to get to your information faster and can ultimately increase your ability to get to the answer. Good luck--we'd be glad to conduct your needs analysis and make recommendations.

C - What you want is online service, so why are you messing with CD-ROM? Is there a commercial market for your database? Problems: Must narrow focus to user who values this information and make it successful. IBM has similar situation (Gaithersburg/Lexington VA) with thousands of publications. Our recommendation is to create central file repository using magnetic tape and do it online--CD-ROM won't save you in the long run.

D - Problems: Base level problems with implementation plan and open architecture per conversation with Major Vercio in developing statement of work. Need to pursue more about compression algorithm, CALS standards, and raster scanning. Integrating text and graphics gets complicated. They are 2 totally different structures and are extremely hard to integrate on screen. Make sure "what you see it what you get." Recommend using SGML document "tags" so able to see both text and graphics. Indexing is so critical.

E - Identify what equipment the users have via a questionnaire. Get a good developer to make recommendations for better performance and upgrade. Indexing is pretty much determined by regulations. Focus on one group at a time (Forms Manager or Librarian) and make it work for them--good news travels fast. Don't spend too much time trying to make it perfect--evolve design once basic user needs are met.

F - Quarterly updates seem too frequent for re-mastering. Recommend supplemental database on hard drive for additional documents during the year. CD-ROM may not be needed if you want available locally all the time. Centrally located database available online over Tymnet with PC and modems. FLITE is available to any DOD agency over public data network at communications charge only (no process charge). Individual organizations billed.

G - Cultural change. Training people to use the new technology and helping them overcome their fear. Refers to trainers sometimes as "co-conspirators", but if they fail you fail. It is the only way to beat this resistance to change. Military emphasis on continuing education puts you well ahead of civilian contemporaries. This is exactly the type of project we were tasked with except for the graphics and I'm living proof that it works like a charm.

H - Be careful not to become equipment dependent. Focus on a pilot project and make it work--it must be important to provide visibility.

I - Look at need for CD-ROM changer (largest seen has been 6) "jukebox." Retrieval programming is critical. 1 million pages is a lot but has seen very successful things done on CD-ROM in larger volumes (60 discs to IEEE test project). Daisy chaining can be done, but not at the snap of the fingers. Biggest consideration will be the size of the indexes--how searchable do you want it. Decision process within bureaucracy will be a challenge I'm sure.

J - Get command (an understanding) on how to do it by learning as much as you can about the technology and potential applications. Identify decisions impacting hardware if you're going to network the CD-ROMs. Network software and CD-ROM drivers not to mention some retrieval software occupy a lot of RAM that can't be used by data. The result is

some applications can't even be run and others become very slow.

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The purpose of this research was to reduce the risk associated with the development and implementation of new technologies through a better understanding of the experiences of current "electronic libraries" program managers. The Air Force has proposed using CD-ROM based technology to create an "electronic master publications library." Structured interviews of ten managers experienced in the development and implementation of similar projects were conducted. The interviewees identified the following as essential success factors in the development and implementation of their projects: planning, identification of user needs, clear and specific goals/objectives, system performance, developer competence, management support, and hardware interface standards. Recommendations based on lessons learned include: avoiding multidisc drives due to problems experienced, updating CD-ROM discs annually with interim changes distributed via magnetic media using software to link with CD-ROM, using the expertise and equipment of contractors in CD-ROM production, and the importance of issues related to computer searching. Finally, it is recommended that further investigation of related studies and issues continue to validate and establish the reliability and generalizability of the essential success factors identified by this study.

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